Care and Feeding

of

Dairy Cattle

by

DEPARTMENT OF ANIMAL SCIENCE

FACULTY OF AGRICULTURE
UNIVERSITY OF ALBERTA
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Care and Feeding of Dairy Cattle

BY

J. E. BOWSTEAD

Dairying in Alberta began with the early settlers and has grown in importance as the population has increased. Experience has shown that conditions in certain areas of Alberta are suitable for dairying. There has been a steady increase in dairy production to the extent that for many years there has been a surplus of dairy products in the province, largely in the form of creamery butter.

Prior to World War II the annual value of dairy production in Alberta was $17,000,000 to $18,000,000. By 1956 the value of dairy products had risen to over $51,700,000. Of this amount the dairymen of the province received over $30,000,000 for the dairy products sold and approximately $9,200,000 represents the value of dairy products consumed on the farm either by the families or by farm animals as skimmilk, buttermilk, whey or whole milk. The balance of $12,500,000 represents the costs of processing and marketing dairy products by the commercial dairy industries in the province.

The large increase in the income from dairying since the prewar years is largely due to increases in the prices of dairy products, since there has been no significant increase in milk production.

The cow population in Alberta has increased as more farm lands became available and as the urban centers increased in size. The increase in numbers was not continuous as there have been significant increases and decreases due to changes in economic conditions as the result of war, depression and competition with other farm enterprises. Following World War II the cow population decreased from 376,400 head in 1945 to 277,600 head in 1951. Since 1951 the numbers have increased to 312,000 head in 1956.

The average yearly production per cow in Alberta has increased over 45% during the past 20 years. In 1936 the average cow produced only 3,100 pounds of milk while in 1956 the average production was over 4,500 pounds. Around the larger urban centers the average production per cow is between 8,000 and 9,000 pounds of milk. In 1956 the commercial herds in the various parts of the province, tested under the supervision of the Alberta Department of Agriculture, averaged 9,173 pounds of milk.

The increase in the average production of cows in the province indicates that there has been a general improvement in breeding and feeding practices during the past 20 years. The fact that many

dairymen have herds that produce two or more times the provincial average demonstrates what has been accomplished by those who have made dairying a major and profitable farm enterprise. Still greater increases in production and efficiency can be secured by continued improvement in breeding, feeding and management practices.

In the event that dairying is to continue as an important industry, it is suggested that improved methods must be adopted in order to increase the net return and at the same time to meet the competition of other farm enterprises and also to survive through periods of relatively low milk and butterfat prices. This bulletin has been published for the purpose of giving practical advice to those already engaged in dairying and to farmers who may be considering establishing dairy herds.

REQUISITES FOR PROFITABLE DAIRYING

Dairying is regarded as an intensive farm enterprise because relatively more capital and labor are required to produce a dollar's worth of product than in the case of most other farm enterprises. Dairying also necessitates a particular knowledge of practices involved in breeding, feeding, maintaining the health of the herd, and care of the raw product, hence it follows that only farmers with these qualifications and an adaptability and liking for this type of farm enterprise are likely to make a success of the business.

The Dairy Cow Must be Well Bred.

Only cows capable of producing enough milk to yield a reasonable income over costs of production can be considered profitable dairy animals. The ability to produce milk in large quantities is inherited, and therefore profitable cows are the result of good breeding and careful selection. In breeding for high milk production type should also be considered because a strong frame, big barrel and a large, well developed mammary system make high milk production physically possible.

The Dairy Cow Must be Well Fed.

Dairying will only prove profitable when the cows are intelligently fed. Since all milk produced is indirectly derived from the feed, the feeding of cows becomes of paramount importance in successful dairying. The rations must contain all the ingredients of milk and in the right proportion for maximum production and greatest economy. The dairyman must know the feed requirements of cows, the composition of feeds, the feeds most suitable for milk production and their cost, if he is to feed his cows most efficiently and secure maximum production from them.

Labor Must be Efficiently Utilized.

Dairying is not a seasonal enterprise. It is a yearly business in which work has to be done every day. The numerous chores that are necessary in dairying must be wisely, efficiently and regularly performed because carelessness and neglect in the proper care of the dairy cow reduce milk production.

Profitable Dairying Requires Both Brains and Brawn.

The combination of good breeding, intelligent feeding, and proper management constitutes the basis for profitable dairying. Any improvement made in the breeding, feeding or care of the herd will increase production as well as profit.

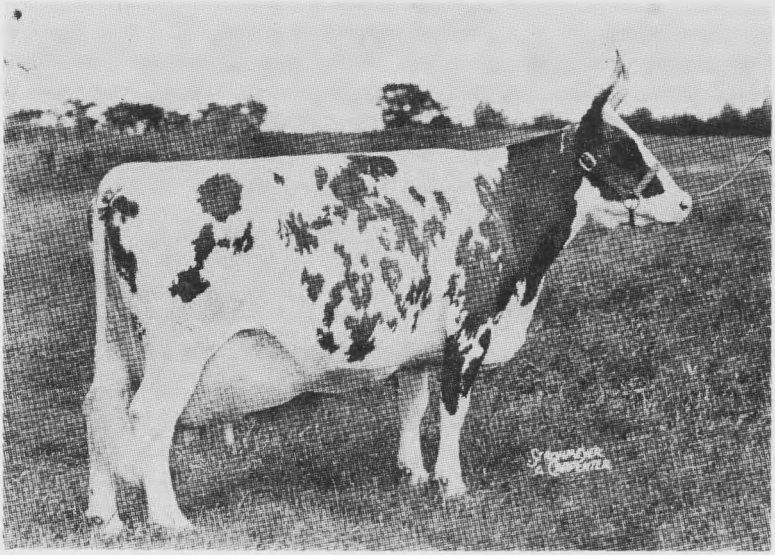

Fig. 1—The highest scoring Ayrshire cow for type and an outstanding producer. Barr Old Style, Imp.

The Ideal Dairy Cow

The ideal dairy cow is one which conforms to the type that makes the production of large quantities of milk physically possible. The type of cow and the ability to produce milk are related. When we breed for production, we also breed to get the type of animal associated with high milk production. The superiority of the pure breeds of dairy cattle over scrub or most grade cattle is the result of over a century of constructive breeding and selection for both type and production. A knowledge of what constitutes good dairy type is essential for the intelligent selection of both males and females if a profitable dairy herd is to be secured.

General Requirements.

An ideal dairy cow must be able to consume and digest large quantities of feed, convert them into milk, reproduce regularly and maintain health and vigor over a long period of years. To be able to do these things, the cow must have (1) a large udder of good quality, long, wide and strongly attached with quarters of equal size and with teats of fair size properly placed; (2) a large barrel, which indicates a large feed capacity, the back carrying this barrel must be strong and straight, and the ribs long and well arched, and (3) a long, broad and level rump to give ample room for calving. Not only do spacious and well formed hind quarters aid reproduction, but they also make possible the development of a desirable mammary system. (4). A large heart girth gives ample room for the heart and lungs, so they will function normally to keep the cow in good health and to lengthen her period of usefulness. (5) Freedom from excess fleshiness when in milk is necessary because there should be a natural tendency for the food nutrients to be manufactured into milk rather than into beef or fat. (6) There should be beauty and style which result from the blending of well developed body parts into a symmetrical whole, and an alertness and carriage which is pleasing to the eye.

BREEDS OF DAIRY CATTLE

Purebreds are Superior.

Improvement of dairy cattle dates back many centuries. The dairy breeds have been developed as a result of careful selection and breeding for increased production, and for a type associated with production. Such planned selection and breeding have continued to be practiced within each breed until at the present time most purebred dairy cows produce more milk and butterfat than cows that are not purebred.

The Choice of a Breed.

The choice of a breed should be based upon the special qualities possessed by each of the different breeds, upon their suitability for conditions under which they will be raised, as well as upon the available markets for particular dairy products and breeding stock. All of the major dairy breeds are being successfully raised in the dairy districts of Alberta, and no one breed has proven to be superior to all others. There has been a tendency in the past for the breeds producing high test milk to predominate in creamery districts, whereas breeds producing milk of lower test predominate in cheese factory districts and on dairy farms near large urban centres. If, however, a dairyman in a creamery area wishes to raise

large numbers of swine or poultry that can utilize large quantities of skimmed milk, cows producing the lower test milk may prove more profitable under his conditions.

Select a Breed Popular in Community.

There are advantages for all dairymen in one community to raise the same breed of dairy cattle, or in districts where the dairy cows are not purebred to use purebred bulls of the same breed. Such a condition facilitates the purchase and sale of breeding stock within the community. In areas where there are many dairy herds of the same breed, it is possible to develop a popular strain of purebred cattle for sale outside the community.

A knowledge of breed characteristics is essential in making a selection of a breed. Each breed has its strong points as well as weaknesses. In making any selection, care must be exercised in obtaining animals that possess both good type and high production, so as to avoid inherent weaknesses often found even among purebreds. The following information should aid in breed selection.

The Holstein-Friesian Breed

Holsteins in Canada have for many years outnumbered all the other dairy breeds combined, and in Alberta rank high in popularity. They are one of the oldest breeds of dairy cattle, having been developed for centuries in the Rhine delta of Europe by the early tribes that settled in that area.

Holsteins are the largest of the dairy breeds, mature cows weighing from 1,300 to 1,600 lb., and mature bulls from 2,000 lb. up. They have strong, large frames and barrels, which give them the ability to consume large quantities of hay and pasture. Although Holsteins increase rapidly in size and weight, they reach sexual maturity comparatively slowly. They are usually bred to calve at from 27 to 30 months of age. Cattle of this breed have strong, rugged constitutions and are hardy and healthy. While Holsteins have adapted themselves to a wide range of conditions, they do best where feed is plentiful.

Based upon production records of thousands of purebred animals, Holsteins produce more milk than those of any other breed, and although their milk may have the lowest average test, the production of butterfat is not surpassed. The average mature Holstein cow produces about 11,900 lb. milk and 437 lb. fat in a 10-month lactation period.

The color is black and white. Most purebred breeders prefer cows that are approximately 50% black and 50% white. Holstein cattle are moderately upstanding, with strong frames, spacious middles and good constitutions, which enable them to withstand

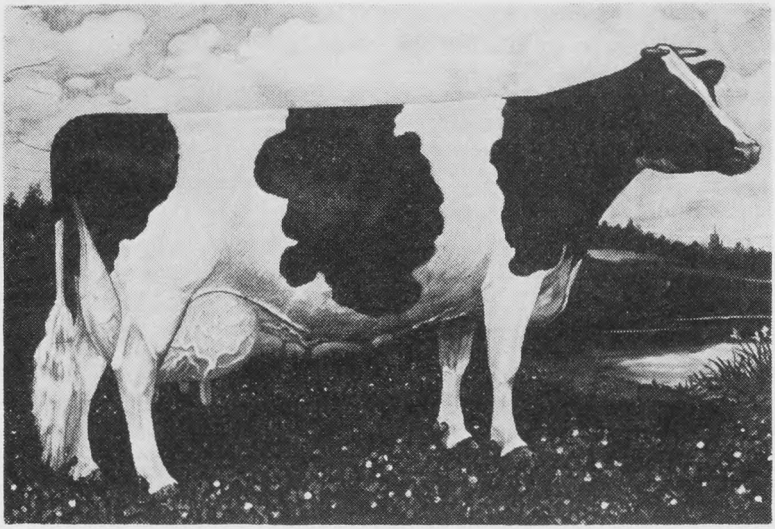

Fig. 2—True type, Holstein-Friesian cow.

cold and rigorous conditions. This fact does not imply that such conditions can be imposed without seriously affecting their milk production.

Holsteins are noted for the extent of mammary development. While the udders are usually large, they are often not as well shaped nor as well attached to the body as is desirable. In former years many Holsteins were criticized for having pendulous udders and large teats of poor shape. The rumps of some animals were inclined to be short or sloping and this was partly responsible for the undesirable shape of some udders. During the past 25 years, purebred Holsteins have been considerably improved in general appearance and dairy form, and the common faults of the udder and rump are being corrected.

Holsteins are docile and even tempered, but at the same time show alertness and vigor which is desired in all dairy cattle. This breed can be successfully raised in all parts of Alberta where pasture and hay are plentiful, and where ample grain is fed to produce large amounts of milk. They are especially desired on farms where large quantities of skimmilk can be used for hog and poultry feeding, and also around large urban centres and cheese factories where whole milk is required.

The Jersey Breed

The Jersey breed of cattle is especially popular in creamery districts where butterfat production rather than milk is the major

objective. Large numbers of Jerseys are also raised near the larger urban centres where there is a demand for milk with a high test. Jerseys have proven themselves to be adapted to most conditions prevailing in the better dairy districts of the province.

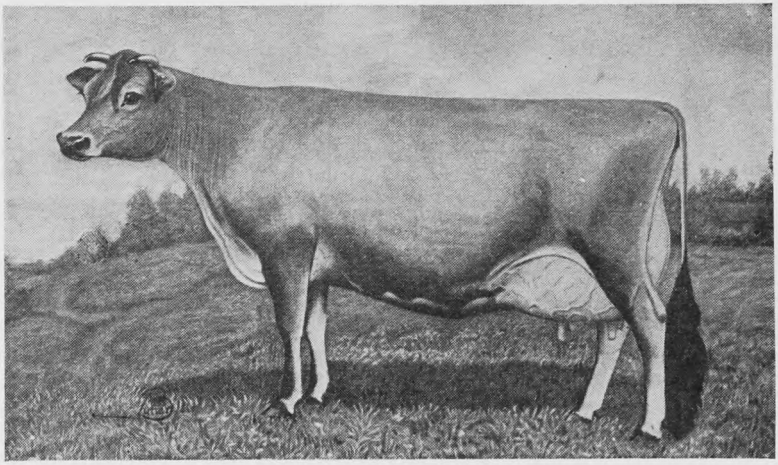

Fig. 3—Standard type Jersey cow, approved by the Canadian Jersey Cattle Club.

The homeland of the Jersey breed is the island of Jersey where centuries ago the people improved the dairy qualities of their native island cattle. In order to preserve these desirable qualities, the Government passed a law in 1763 which prohibited the importation of any live cattle to the island. Since that time the improvement has continued, and animals are being exported to all parts of the civilized world.

The breed is the smallest of the major dairy breeds. Mature cows weigh between 900 and 1,100 lb., and bulls from 1,300 to 1,600 pounds. They are the most refined of all the dairy breeds, being relatively fine in bone and usually free of excess flesh. Considering their small size, Jerseys have large barrels, enabling them to make use of rations containing a large proportion of roughage. They mature rapidly and can be bred to calve at 24 to 26 months of age, or even earlier if well developed. Jerseys are also noted for their longevity, and many cows produce calves regularly to a relatively old age.

Jersey milk has the highest butterfat test. The high test milk produced by Jerseys reduces the feed requirement for butterfat production below that of lower testing breeds. While the average test of the milk is around 5.4%, many of the better animals of the

breed average over 6%. The average mature Jersey produces about 7,600 lb. milk and 410 lb. butterfat in a 10-month lactation period.

Jersey cattle range in fawn color from light gray, cream, yellow, red, even to dark brown. The lighter colors are the most popular. Solid colored animals are preferred to those with white spotting, although in recent years animals with white markings have been increasing in number. Bulls are usually darker in color. The muzzle is always black, but the tongue and switch may be either black or white.

Jerseys show pronounced dairy temperament as indicated by their freedom from excess flesh, quality of skin, and refinement of bone. The excess refinement of some animals may lead to weakness of body frame and lack of constitution, ruggedness and apparent thrift. The lack of size and extreme leanness of the Jersey make them of little value for beef or veal. The udder shape and body attachment are usually very good. Jerseys have a very active disposition and are very alert. Nevertheless they are very docile and are recognized as the family cow. When improperly managed there is a tendency for some bulls of this breed to become unruly or vicious.

Jerseys are noted for their adaptability to most conditions. They are well adapted to humid and hot climates, but are not considered hardy enough to withstand exposure to extremely cold weather. While they may suffer more from the extreme cold of Alberta winters than certain other breeds, it is fair to say that such exposure is often the result of poor management. Jerseys have thrived on Alberta farms whenever they have been well housed and cared for.

The Ayrshire Breed

Ayrshire cattle have become better established in eastern Canada than in the western provinces. In Alberta the Ayrshire breed has gained a foothold in quite a number of districts and has contributed substantially to the dairy industry of the province. The Ayrshire breed had its origin in the county of Ayr in Scotland, where the climate was rigorous and feed none too plentiful. With the adoption of better agricultural methods, crop production increased and the livestock could be better fed and cared for. Breed type was emphasized during the period of improvement, and this fact accounts for the uniformity of type of present-day Ayrshires.

Ayrshire cattle are fairly uniform in their ability to produce milk and butterfat. The average production for a mature Ayrshire cow is about 8,800 lb. milk and 356 lb. fat for a 10-month lactation period. The average test of Ayrshire milk is 4%. The

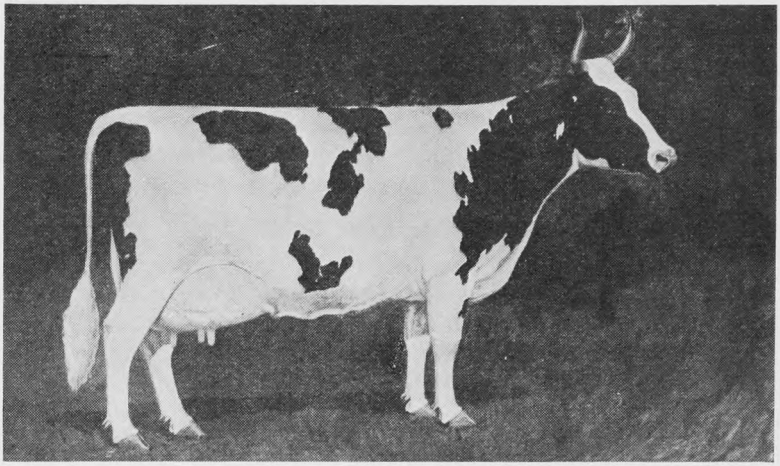

Fig. 4—Model Ayrshire cow.

fat globules are small, and this is regarded as an advantage in cheese making and for infant feeding. Ayrshires have, however, been criticized for the short lactation periods. This is being overcome by better breeding and feeding practices. Breeders claim that their animals are long lived, and lifetime records are encouraged to show how long Ayrshires can produce and reproduce efficiently.

They are of medium size, mature cows weighing between 1,100 and 1,300 lb., and bulls over 1,650 pounds. In general conformation Ayrshires show a compact body, a strong straight back, good in both shoulder and rump, and with a large barrel. They are lower set than the Holsteins. The udder is usually well proportioned and well attached to the body. Their well-balanced form and stylish carriage give them a very attractive appearance. Ayrshire cows in milk, when reasonably well fed, carry a fair amount of flesh, but do not appear beefy.

The color of Ayrshires is red and white spotted. The shade of red may vary from cherry to a reddish mahogany. Likewise there is a great deal of variability in the amount of red, from an almost solid red to an almost solid white.

They are unsurpassed as grazers on rough sparse pastures. This may be the result of their early environment and active disposition. Ayrshires have splendid appetites and will consume large quantities of roughage. The heavier producing Ayrshire requires a fair amount of grain, but if too heavily fed will often become fat. While

the disposition of the cow is good, some Ayrshire bulls are apt to become vicious and hard to manage when not properly handled.

The fact that Ayrshires are hardy and active, with the ability to rustle, makes them adapted to most parts of Alberta. While they have proven more suitable than the other breeds in the rougher and less fertile areas, they have also held their own in the better dairy districts of the province in competition with other breeds.

The Guernsey Breed

Guernsey cattle were the last of the dairy breeds to be introduced into Canada. They are more popular in eastern Canada than in the western provinces. Guernseys are similar in many ways to Jerseys, having been developed under similar conditions in the Channel Islands. They are a little larger than Jersey cattle but somewhat similar in conformation. While the color of both breeds is various shades of fawn all Guernsey cattle carry white markings. Guernsey milk is lower in test than Jersey milk, but richer in color due to a higher carotene content. There is a tendency for Guernsey cattle to be less refined than Jersey cattle and the udders are not as well proportioned and attached as are those of the Jerseys. Breeders are striving to correct the faults mentioned, and much improvement has already been accomplished.

The breed is as well adapted to Alberta conditions as is the Jersey, and the successful raising of Guernseys in the province is dependent upon the continued improvement in the existing herds.

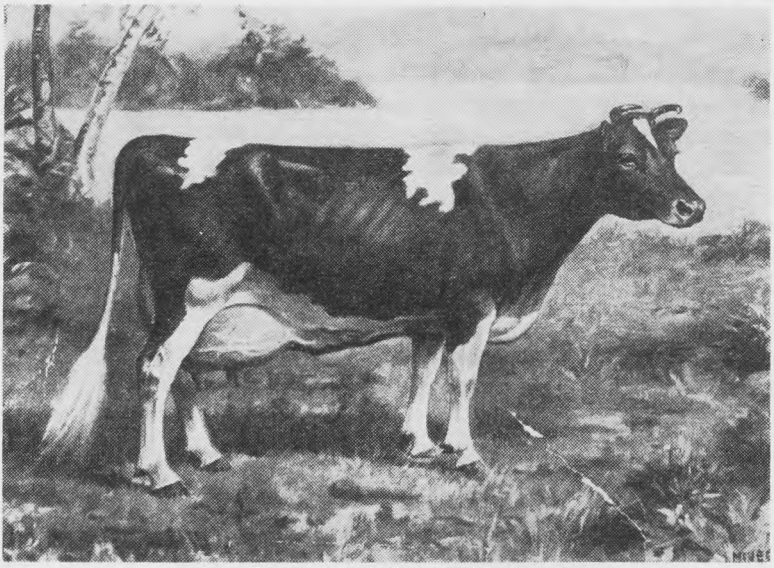

Fig. 5—Model Guernsey Cow.

Dual Purpose Breeds

While it is admitted that dual purpose cattle are not as efficient producers of milk or beef as the specialized breeds, they may prove particularly useful in areas not suited to specialized dairying. These cattle can be recommended for farms where diversification is an important consideration. Dual purpose cattle are not, however, recommended for areas well suited to specialized dairying, as the lower income that would be secured from milk production would not be offset by the higher income from beef production.

The Red Poll and the dairy strain of Shorthorns are the two most popular breeds of dual purpose cattle in Alberta. Breeders of such cattle do not strive for as high production records as do breeders of specialized dairy cattle, since by so doing the beef qualities may be lowered. Although the number of purebred cattle of these breeds is relatively small, their beef quality is good, and many commendable production records have been made.

High Grade and Crossbred Dairy Cattle.

The continued use of well selected purebred dairy bulls of one breed in non-purebred herds for several generations will increase the level of production to nearly that of purebred dairy cattle. Many high producing commercial herds in Alberta have been developed by using this system of breeding.

The crossing of two breeds of dairy cattle has been successfully practiced for many years in Great Britain and other European countries. The production of the crossbred females is often greater than the average of their parents. This system of breeding, however, necessitates the continued maintenance and improvement of purebred dairy cattle.

The choice of raising grade, crossbred or purebred dairy cattle should be based not only on economic factors but on the dairyman's interest in and ability to carry out a certain system of breeding. Each system has its advantages and disadvantages and has been successfully practiced.

SELECTION OF DAIRY CATTLE

Proper Selection is Very Important.

The proper selection of dairy cows, heifers and bulls is of fundamental importance if the greatest profit in dairying is to be realized. Whether selection is for foundation animals to start a herd, for heifers to replace older or unprofitable cows, or to obtain a suitable bull, the choices made determine to a large extent the degree of success that will be attained in the dairy business.

There are several things necessary in properly selecting dairy animals, namely, an understanding of the ideal type, and ability to interpret and evaluate production records and pedigrees. Furthermore, it is necessary to understand how much importance should be given to each of these items in selecting any one animal.

How to be a Good Judge.

To be a good judge of dairy cattle requires not only a knowledge of what constitutes the ideal type, but also practical experience in handling stock. This experience helps one to observe and understand the degree of relationship that exists between production and conformation.

Knowledge of what constitutes general dairy type, together with the special breed-type standard adopted for each of the dairy breeds can be gained from the livestock journals and other publications, as well as at the livestock fairs. Each breed association has adopted a system of classifying cows according to type. This is not only an aid to selection, but educates the breeder in what constitutes breed type. This system is also used for classifying bulls according to a combined value for type as well as breeding so that an officially classified bull would be one of suitable type and out of parents of good type and performance.

Production Records Important in Making Selection.

Selection can be made more accurate by giving consideration to production records, as well as to type. This is because production is also an inherited characteristic and thus it is possible for some cows of good type to be poor producers. Production is quoted in terms of milk as well as butterfat, but before these quantities can be properly evaluated, the conditions under which the records were made are needed. The age of the cow, times-a-day milked, and length of lactation period all affect production and must be considered in determining the producing ability of a cow most accurately.

Pedigree Study Aids Selection.

The consideration of an animal's pedigree also can make selection more accurate. Milk producing ability as well as type is transmitted from one generation to the next.

When the animal to be selected is immature, its ultimate type and producing ability cannot be correctly judged by its appearance, since the animal is not fully developed. Because these characteristics are transmitted from generation to generation a knowledge of the type and production of its ancestors can be used as an indication of how the immature animal will develop.

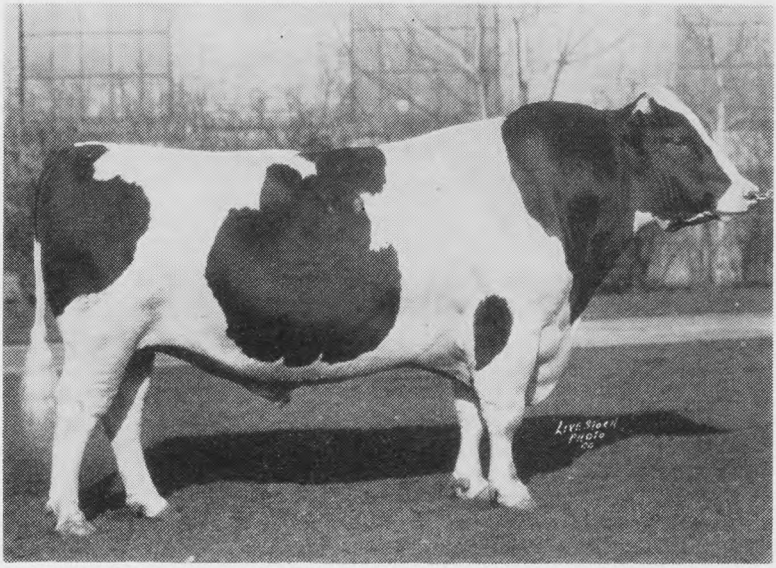

Fig. 6—Johanna Rag Apple Pabst, an outstanding show bull that contributed greatly to the improvement of the breed through both sons and daughters.

The contribution of any ancestor to the inheritance of an individual is halved for each generation farther removed from the individual being considered. Ancestors three and four generations back on the pedigree contribute comparatively little to an animal's inheritance and therefore should not be given undue consideration. In making selection, therefore, it is most important to find out all one can about the immediate parents of an animal.

Pedigree Study Most Important in Selection of Young Animals.

The amount of consideration to give an animal's pedigree and how much to the individual type depends upon its sex, age and the amount of reliable information concerning the ancestors that is known. In selecting a mature cow, her type, mammary development and own performance are accurate indications of what she actually can produce. A further study of her pedigree would, however, give an indication of what inheritance she would transmit to her offspring. In selecting a mature bull, the type and production of his daughters indicate accurately his breeding ability, and are much more reliable than the performance of his ancestors. However, when selecting a bull calf for the future herd sire, a great deal of consideration should be given to his pedigree.

BREEDING PROBLEMS

Cows that freshen once every year produce more milk during a normal lifetime than those that freshen at any other rate. In well established dairy districts it is desirable to have the cows freshen periodically throughout the year in order that the same quantities of milk can be shipped at all times.

Difficulties are often experienced in successfully breeding cows to freshen at the times planned. The cows either fail to come in heat or fail to become pregnant when bred. The failure of cows to come in heat or to become pregnant may be due to: (1) diseases of the reproductive organs, (2) nutritional deficiencies, (3) abnormal reproductive organs, and (4) the bull may be an inefficient breeder.

Disease

Contagious abortion (Bang's disease), vibrio and vaginitis are caused by bacteria or viruses that invade the reproductive organs and cause abortion any time following service. Retention of afterbirth often leads to infection of the uterus by necrotic bacteria. The infection from this cause may be so great as to make further reproduction impossible. Vaccinating calves to prevent contagious abortion (Brucellosis) and keeping the cows healthy by proper feeding, care and sanitation, prevent breeding difficulties that are caused by disease. See section on diseases and treatments, pages 69 to 85.

Nutritional Deficiencies.

Cows that are extremely thin due to improper feeding or because of heavy milk flow may fail to come in heat or to become pregnant. Cows must be in good health and thrift if their reproductive organs are to function normally.

When cows appear to be in fair flesh and good health but fail to come in heat or become pregnant when bred, the trouble may be due to some specific vitamin or mineral deficiency. Injections of ascorbic acid (vitamin C) and the feeding of wheat germ oil have cured some nutritional cases of sterility. Lack of minerals such as calcium, phosphorus, iodine, iron and others has reduced the thrift of cows sufficiently to cause sterility.

Cows that are liberally fed good quality hays and grains with iodized salt and a simple mineral supplement should reproduce normally. There is also less possibility of a nutritional deficiency causing poor breeding when cows are on pasture. When cows are being properly fed and yet fail to get with calf, other causes for breeding difficulties should be explored.

Abnormal Reproductive Organs.

The failure of cows to have normal heat periods or to conceive, or give birth to normally developed calves may be due to abnormal development or functioning of the reproductive organs. These may be due to nutritional deficiencies, disease, or to inheritance.

Cows in poor health on account of some debilitating disease, and cows improperly fed sometimes fail to reproduce because their reproductive organs fail to function normally. Cystic ovaries cause cows to remain in constant heat and no reproduction is possible until the cysts have been broken down by mechanical treatment.

Cows vary in their ability to reproduce due to differences in their inheritance. This has been borne out by the fact that cows of different families have shown differences in their ability to reproduce. Inbreeding has often been the cause of lower fertility.

Twin calves are believed by some dairymen to be non-breeders when they reach maturity. Scientific studies have proven that it is only the twin heifer of a bull calf that is usually sterile. This is due to the fusion of the embryonic coverings of both calves which allows the blood streams to mix. The hormones in the blood of the unborn bull calf prevent female reproductive organs developing in the twin heifer, causing permanent sterility. Such heifer calves should either be vealed or raised for beef, as only about one in twelve is likely to be fertile. When twins are of the same sex their reproductive organs develop normally and their full reproductive ability is attained.

Inefficiency of the Bull.

The failure of cows to become pregnant when conditions for normal reproduction appear satisfactory may be due to the bull being unable to produce normal semen. When a bull develops this inability, most or all of the cows bred to him will fail to get with calf, and will continue to come in season during the following heat periods.

There are many causes for bulls being unable to breed cows successfully. Overwork, lack of exercise, nutritional deficiencies and injuries are a few of the reasons why bulls become poor breeders. Most of these causes can be overcome by proper feeding and management.

Excessive use of the bull reduces the number and vitality of sperm cells. The semen of bulls used too seldom contains many dead sperm cells. Bulls confined to small stalls or kept in small pens without exercise may become slow breeders and may not be able to serve a cow properly.

Feeding bulls too little feed, feeding rations low in proteins or the feeding of large amounts of silage may cause them to be slow and not dependable breeders. Specific mineral and vitamin deficiencies may also cause bulls to develop the same symptoms. The feeding of rations containing some legume hay or protein supplement should help in preventing bulls becoming unsatisfactory breeders. The injection of ascorbic acid and the feeding of wheat germ oil have been used with some success to correct specific deficiencies. Bulls sometimes injure their sex organs in fighting or in breeding cows. This may result in their indifference to the cows they serve, or in apparent failure to carry out the complete breeding act.

ARTIFICIAL INSEMINATION

The use of artificial insemination is rapidly increasing in Alberta. During the past few years eight cooperative breeding associations have been formed and are now operating at Edmonton, Lethbridge, Lacombe, Ryley, Camrose, Stettler, Acme and Olds. Artificial insemination is being practiced at Wetaskiwin, Westlock and Calgary by local veterinarians or qualified independent operators. Based upon figures secured by the Livestock Branch of the Alberta Department of Agriculture, between 11,000 and 12,000 cows were artificially bred in 1956.

The use of artificial breeding is a powerful means of increasing herd production because it enables the average breeder to secure the services of bulls much superior to those he could afford to buy. It eliminates the need of buying and caring for herd sires, especially for the smaller herds. Artificial insemination is also used to prevent or control certain diseases.

Breeding cows artificially requires special equipment, and the collection, preparation and insemination of the semen require technical and sanitary practices. For these reasons, only men specially trained for the work are employed to perform all the necessary operations in artificial breeding from semen collection to insemination.

Under artificial insemination the semen from a bull is collected in an artificial vagina. It is then tested for sperm cell viability and concentration, is diluted and made bacteriologically sterile. The semen is then measured into small vials sufficient for one service and cooled or frozen for shipment to breeding associations or approved inseminators.

None of the artificial breeding associations in Alberta keeps bulls to furnish semen. The semen is purchased in vials from British Columbia or Ontario. The semen from British Columbia

is received several times each week, and because it is not frozen it must be used in the course of a few days. The semen from Ontario is frozen and because it can be stored in that state for long periods it is shipped to associations less often. Members of breeding associations can usually have their cows inseminated with the semen of one of several bulls.

A rapid increase in the use of artificial insemination is expected with the formation of more associations organized for that purpose. The Alberta Department of Agriculture provides some financial assistance to newly-formed associations providing that they have a sufficient number of cows signed up within a limited area, to indicate future development of a self-sufficient unit, and hire an approved technician. Rules have been adopted by the purebred dairy cattle breed associations governing the use of artificial insemination in purebred herds and these and other regulations are incorporated in the by-laws of breeding associations.

Artificial insemination can greatly improve the economic aspects of the dairy enterprise through a material increase in milk production.

FEEDING

Scientists have determined the nutrient requirements of dairy cows and the best means of providing those nutrients. We now know what nutrients the different feeds contain and how much of each the cow can utilize. Feeding trials have shown that when the proper principles of nutrition are applied, the maximum quantity of milk is produced and the feed is used most efficiently. Feeds are known to vary in their suitability for milk production and, of course, they also vary in price. If dairymen will use the information that is available to them, milk will be more efficiently produced and dairying will become more profitable.

Composition of Feeds

All feeds have been analyzed for the nutrients they contain. It is, therefore, of primary importance in feeding animals to know what nutrients are being fed, both as to kind and quantity. Feeds are analyzed for the following substances:

Moisture.—All feeds contain moisture. Green roughages, pastures and the silages may have from 65% to over 90% moisture, while hays and grains vary around 10% depending on the moisture in the air and the length of time the feed is stored. The more moisture a feed contains, the lower will be the proportion of other nutrients.

Protein.—Proteins are complex chemical compounds that are of vital importance in the feeding of dairy cattle because they are

most likely to be fed in insufficient amounts. Proteins are the only group of common nutrients that contain nitrogen. Feeds containing relatively large amounts of protein are sometimes described as nitrogenous. Milk, alfalfa hay and such feed by-products as linseed meal, wheat bran and shorts contain relatively large amounts of protein.

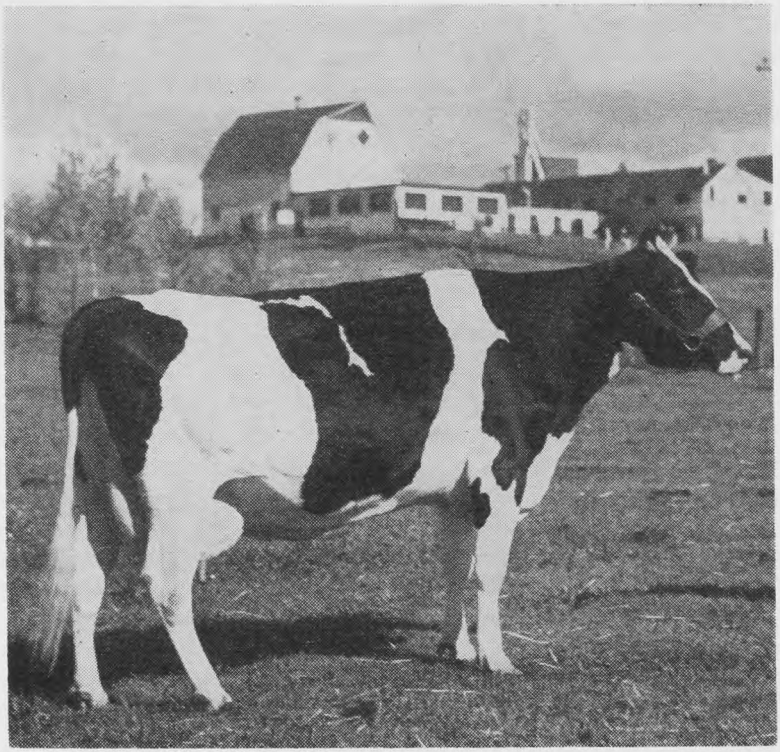

Fig. 7—Alcarta Gerben, Canadian champion butterfat producer, 1409 lb. fat in 365 days. Owned by Hays Limited, Calgary, Alta.

Crude Fiber.—Crude fiber is the most indigestible part of any feed, and consists largely of celluloses and other similar substances that give rigidity and shape to plants. It is, therefore, high in such material as stalks and stems and lower in leaves and seeds. Feeds low in crude fiber and therefore high in digestible nutrients are called concentrates. Feeds high in fiber and therefore comparatively low in digestible nutrients are called roughages. Grinding roughages does not convert them to concentrates because the crude fiber content remains the same. Roughages with their high crude fiber content give bulk to the ration. In this connection it

should be kept in mind that efficient feed utilization by cattle is only attained when there is ample bulk supplied.

Nitrogen-free extract comprises all the readily digestible feed substances other than fat, fiber and protein. Nitrogen-free extract consists largely of starches together with very small amounts of sugar. Feeds that contain relatively large amounts of nitrogen-free extract and smaller amounts of protein are called starchy, or more commonly, carbonaceous feeds.

Fats.—The fats in feeds are largely stored in the germ of the seed as a concentrated form of energy. Feed fats vary in hardness, and may have a definite effect on the quality of butter.

Ash.—When feeds are burned, the ash that remains contains the minerals of the feed. The bones, muscle, blood and milk of animals contain relatively large quantities of minerals. Minerals must be supplied if animals are to grow, reproduce, lactate and remain in good health. Common salt, iodine and calcium, and occasionally phorphorus, are the minerals that are usually not obtained in sufficient quantities from the feed, and therefore must be supplied as supplements.

Function of Feeds

The nutrients in feeds are used (1) to supply energy for the work done by the vital organs of the body, such as the heart, lungs and digestive tract, (2) for the maintenance of body temperature, (3) for the repair of tissues, (4) for the building of new bone, muscle and fat tissues during the period of growth, pregnancy and fattening, (5) to provide the necessary ingredients required for the secretion of milk. In connection with every function of the animal body, specific amounts of the different nutrients are required.

For maintenance alone, the nutrient requirements are chiefly for nitrogen-free extract and fat with very little protein or minerals being required. The bigger the animal, the greater is the nutrient requirement. Exposure to extreme cold increases the requirement. Carbonaceous roughages alone can usually provide sufficient nutrients for maintenance.

Growth and pregnancy involve a building up of flesh and bone. These are largely composed of protein and mineral. The faster an animal grows, the greater will be the need for protein and mineral supplements. Newborn calves grow very rapidly, and as they become older their growth rate decreases, reducing their need for protein and minerals. Pregnant cows require a little more feed than for maintenance alone.

Fattening requires a surplus of feed above other requirements. A dairy cow that fattens while producing milk is either getting too

much feed or is using feed for body fat rather than for milk production. Fattening cows prior to freshening is sometimes practiced to increase milk production during the following lactation period. Thin cows may be fattened during their dry period by feeding an excess of carbonaceous or starchy feeds. Very little protein or minerals are required in this process.

Milk secretion calls for relatively large quantities of protein and minerals in the feed. Some cows have difficulty in eating and digesting sufficient feed to meet their requirements for milk secretion because the inherent ability to produce milk has been increased to such high levels. So great is the nutrient requirement for heavy milk production that only by careful planning will the ration provide the cows with the right amount of the required nutrients. When an insufficient quantity of any nutrient is fed, cows cannot produce milk to the limit of their ability. Feeding lactating cows a ration containing a variety of palatable feeds reduces the possibility of certain deficiencies developing. The liberal feeding of a varied ration containing sufficient protein and minerals is essential for maximum milk production.

The rations for immature cows should contain the combined nutrients required for maintenance, growth, pregnancy, as well as for milk production, because they are still growing and are rebred while still lactating.

Cows producing 30 lb. of 3.5% milk require almost twice as much feed as dry cows to meet their nutrient requirements. This extra feed for milk production must be provided chiefly in the form of a concentrate mixture, because cows are limited in the amounts of roughage they can consume.

Yearly Feed Requirements for Dairy Cattle

Successful dairymen grow most of the pasture and other feeds required by their dairy herds. To do this requires a knowledge of the amounts of pasture, hay, grain, protein supplements and minerals that should be fed to meet the yearly requirement for the entire herd.

The following information is based upon the yearly requirement of an average cow weighing 1,200 lb. and producing 4% milk. A dairyman with 10 cows would require 10 times these amounts of feed plus the requirement for his young stock. Cows producing more milk than the following tables indicate, or producing milk with a high butterfat test would require more feed than is indicated.

Roughage.

Three tons, plus adequate grazing during the pasture season.

Pasture.

2 to 2½ acres cultivated pasture in high productive areas with good soil and ample rainfall.

3½ to 4 acres cultivated pasture in medium productive areas with only fair soil and rainfall.

1 acre of good irrigated pasture.

3 acres native pasture or 10 acres bush land equal 1 acre cultivated pasture.

Minimum pasture requirements should only be provided when good management and rotational grazing are to be followed.

Concentrates.

Level of Production Pounds milk per cow	Grain required with summer pasture (no supplement)	Grain required with winter feeding (no supplement needed with legume hay)	Amounts of a 24% protein supplement that should be included as a portion of the grain when a mixed hay or a grass or cereal hay (oat bundles) is fed.	
			Mixed hay	Grass or Cereal hay
6,000	200 lb.	1,000 lb.	175 lb.	400 lb.
8,000	500 lb.	1,600 lb.	280 lb.	650 lb.
10,000	800 lb.	2,100 lb.	370 lb.	850 lb.
12,000	1,100 lb.	2,700 lb.	475 lb.	1,100 lb.

Example: Cows with yearly production of 8,000 lb. milk being fed brome hay would require a total of 1,600 lb. concentrate mixture composed of 950 lb. grain and 650 lb. protein supplement during the winter feeding period, plus the 500 lb. grain required during the pasture season.

Note: The 24% protein supplement can consist of 60% wheat bran and 40% linseed meal.

Where it is the practice to have the majority of the cows calve in the spring there will be a reduction of protein supplement required, and there will be a larger proportion of the total grain fed on pasture.

Minerals.

40 to 60 lb. iodized salt per cow per year. When no legume hay is fed 1% bone meal should be added to the grain mixture of high producing cows.

Bedding.

1800 lb. per cow per year in a stanchion barn.

3100 lb. per cow per year in a loose housing barn.

Young Stock Requirements.

Calves:

Milk, skimmed and whole—1000 lb. (¼ wholemilk and ¾ skimmilk).

Grain—900 lb.

Hay—1800 lb.

Pasture—from four months on.

Yearlings:

Hay—3600 lb.

Grain—1000 lb.

Pasture—as for milking herd.

Nutritional Value of Feeds

The nutritional value of a feed depends upon how well it satisfies the nutrient requirements of an animal. A chemical analysis of a feed shows the percentage content of the various nutrients, but does not show how much is digestible nor how palatable a feed is. According to the Feeding Stuffs Act all commercially prepared feed mixtures and feed by-products offered for sale in Canada must be accompanied by a list of ingredients, and a guaranteed chemical analysis for certain of the nutrients, to enable the buyer to estimate their relative feeding value.

TABLE I

Average Percentage of Digestible Nutrients in Feeding Stuffs*

Feeding Stuff	Total Dry Matter %	Dig. Protein %	Total Dig. Nutrients %	Nutritive Ratio 1:
Dry Roughages.				
Alfalfa hay, all analyses	90.5	10.9	50.7	3.7
Alfalfa meal, dehydrated	92.7	12.4	54.4	3.4
Alfalfa straw	92.7	4.7	42.6	8.1
Barley hay	90.8	4.0	51.9	12.0
Barley straw	90.0	0.7	42.2	59.3
Brome grass hay, all analyses	88.8	5.3	49.3	8.3
Clover hay, alsike, all analyses	88.9	8.1	53.2	5.6
Clover hay, red	88.3	7.2	51.8	6.2
Clover hay, sweet, second year	90.7	9.5	47.3	4.0
Oat hay	88.1	4.9	47.3	8.7
Oat straw	89.8	0.7	44.8	63.0
Prairie hay, western, cut in midseason	91.3	2.0	45.1	21.6
Red top hay	91.2	3.3	49.3	13.9
Reed canary grass hay	91.1	4.9	45.1	8.2
Timothy hay, before bloom	89.0	6.1	56.6	8.3
Timothy hay, full bloom	89.0	3.2	51.1	15.0
Wheat grass hay, slender	90.0	4.6	50.8	10.0
Wheat straw	92.6	0.3	40.6	134.3
Roots and Tubers.				
Potatoes, tubers	21.2	1.3	17.4	12.4
Turnips	9.3	0.9	7.8	7.7
Silages.				
Oat	28.3	1.1	15.4	13.0
Sunflower	22.6	1.0	12.2	11.2
Grass, considerable legumes	25.6	2.0	15.5	6.8
Concentrates.				
Barley	89.4	10.0	77.7	6.8
Beet pulp, dried	91.2	4.1	68.7	15.8
Beet pulp, wet	11.6	0.8	8.8	10.0
Brewers' grain, wet	23.7	4.2	16.1	2.8
Brewers' grain, dried	93.0	22.0	67.1	2.1
Flaxseed	93.8	21.8	108.3	4.0
Linseed meal, all analyses	91.1	30.6	75.5	1.5
Meat scraps or dry rendered tankage, 55% protein grade	94.2	45.0	66.7	0.5
Molasses, beet	80.5	4.4	60.8	12.8
Oats	90.2	9.4	70.1	6.5
Skimmilk, centrifugal	9.5	3.4	8.7	1.6
Soybean oil meal, solvent, all analyses	90.4	42.0	78.1	0.9
Wheat, hard spring	90.1	13.3	80.7	5.1
Wheat bran, hard spring	90.5	14.1	67.5	3.8
Wheat screenings, good grade	90.4	10.0	68.7	5.9
Wheat standard middlings, hard wheat	90.5	14.5	77.6	4.4

*Taken by special permission of the Morrison Publishing Co., Ithaca, New York, from the extensive data in "Feeds and Feeding," 22nd Edition, by F. B. Morrison.

The relative feeding value of the various farm-grown feeds and feed by-products has been determined by numerous digestion trials.

The average per cent digestible protein and total digestible nutrient content for the feeds commonly fed to dairy cows presented in Table I are based upon the results of these trials. The table also shows the ratio of digestible protein to the other digestible nutrients — nutritive ratio.

What is a Suitable Ration?

Not all rations calculated to meet the protein and energy requirements are suitable. They may be deficient in other nutrients, provide insufficient bulk or lack palatability.

Rations to be suitable must contain:

1. Sufficient protein and digestible nutrients to meet requirements.
2. A variety of feeds, so that protein, mineral and vitamin content of one will offset the deficiencies of another.
3. Feeds that are palatable so that animals will consume their full daily allowance.
4. Sufficient bulk to maintain efficiency of digestion.
5. Feeds that supply the required nutrients at a low cost.

Rations should also be slightly laxative.

Suggested Concentrate Mixtures

Herd concentrate mixtures will be largely determined by the roughages which are being fed and also by the concentrate feeds available. Sample herd concentrate mixtures that will meet the requirements of dairy cows fed different kinds of hay are shown in the following table.

TABLE II.

Suggested Herd Concentrate Mixtures

17% Protein Mixtures

A.—For cows fed only grass or cereal hays:	1 lb.	2 lb.	3 lb.	4 lb.	5 lb.
Oats	585	725	625	500	560
Barley	.....	.....	.....	170	220
Wheat	.....	.....	100	.....	.....
Wheat Screenings	240	.....	.....	.....	.....
Wheat Bran	.....	100	150	150	120
Linseed Meal	175	175	.....	180	.....
Soybean Oil Meal	.....	.....	125	.....	.....
Meat Scraps	.....	.....	.....	.....	100
	1,000	1,000	1,000	1,000	1,000

14% Protein Mixtures

B.—For cows fed roughages composed of about one-third alfalfa and two-thirds grass or cereal hays:	6 lb.	7 lb.	8 lb.	9 lb.	10 lb.
Oats	600	750	750	600	750
Barley	225	.....	195	100	.....
Wheat	.....	.....	.....	.....	175
Wheat Screenings	100	.....	.....	.....	.....
Wheat Bran	.....	200	.....	270	.....
Linseed Meal	75	50	.....	30	75
Soybean Oil Meal	.....	.....	55	.....	.....
	1,000	1,000	1,000	1,000	1,000

13% Protein Mixtures

C.—For cows fed roughages composed of about two-thirds alfalfa and one-third grass or cereal hays:	11 lb.	12 lb.	13 lb.	14 lb.	15 lb.
Oats	700	600	750	850	600
Barley	.....	200	100	120	150
Wheat	100	.....	115	.....	.....
Wheat Screenings	.....	.....	.....	.....	100
Wheat Bran	200	200	.....	.....	150
Linseed Meal	.....	.....	35	.....	.....
Soybean Oil Meal	.....	.....	.....	30	.....
	1,000	1,000	1,000	1,000	1,000

Commercial Feeds.

Commercial feed companies are selling mixed protein supplements which when added to certain amounts of ground grain form suitable mixtures containing amounts of protein similar to that recommended in the above suggested grain mixtures.

For example: If 100 pounds of a mixed protein supplement with a guarantee of 24% protein is mixed with 210 pounds of a mixture of two-thirds oats and one-third barley, the resulting 310-pound mixture would only contain approximately 16% protein.

To make a concentrate mixture containing	Mix 100 lb. of a 24% mixed protein supplement with the following amounts of ground oats and barley	Mix 100 lb. of a 32% mixed protein supplement with the following amounts of ground oats and barley
17% protein	145 lb.	310 lb.
16% "	210 "	420 "
15% "	325 "	610 "
14% "	560 "	1,010 "
13% "	1,435 "	2,480 "

Thumb Rules for Feeding.

For roughage.—On the average, cows will consume from 2 to 2½ lb. of roughage daily for each 100 lb. live weight. They will eat more roughage when it is of good quality and palatable. The more roughage of good quality cows will eat, the less of the concentrate mixture will be required. While full feeding of hay is recommended, cows are unable to eat much over 2½ lb. daily for each 100 lb. live weight when no grain is fed, or much over 2 lb. when grain is heavily fed. Silage can replace hay at the rate of 3 lb. for each pound of hay.

For concentrates.—There are three rules that can be used as guides for the feeding of concentrates:

1. Feed 1 lb. concentrates daily for each 3 to 4 lb. of milk, depending upon the test of the milk. For cows producing milk under 4% butterfat, 1 lb. of concentrates for each 4 lb. of milk is usually sufficient.
2. Feed 1 lb. concentrates daily for each pound of butterfat produced in a week. While this method is a little more accurate, it necessitates periodic testing of the milk to enable calculation of the weekly butterfat production.

3. Feed concentrates according to a plan which takes into account the amount of hay fed, or quality of pasture as well as the test of the milk produced, as is shown in tables IIIa and IIIb.

TABLE IIIa.

Grain Feeding Table for Cows Not on Pasture*

Hay equivalent consumed per 100 lb. of live weight daily			Total pounds of grain or concentrates to feed					
			% of fat in milk					
2½ lb. very liberal feeding of good roughage	2 lb. usual rate of feeding good hay or good hay and silage	1½ lb. feeding scanty amt. of good roughage or feeding poor roughage	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
Milk produced daily, pounds			lb.	lb.	lb.	lb.	lb.	lb.
17	10	....	.....	.....	1.9	2.2	3.1	3.5
21	14	....	2.0	2.4	3.8	4.2	5.3	5.7
25	18	11	3.6	4.2	5.6	6.2	7.4	8.0
29	22	15	5.2	5.9	7.5	8.2	9.5	10.2
33	26	19	6.8	7.6	9.3	10.2	11.6	12.5
37	30	23	8.4	9.3	11.2	12.2	13.7	14.7
41	34	27	10.0	11.1	13.1	14.2	15.8	17.0
45	38	31	11.6	12.8	14.9	16.1	18.0	19.2
49	42	35	13.2	14.5	16.8	18.1	20.1	21.5
53	46	39	14.8	16.3	18.7	20.1	22.2	23.7
57	50	43	16.4	18.0	20.5	22.1	.....	.....
61	54	47	18.0	19.7	22.4	.....	.....	.....
65	58	51	19.6	21.4	24.2	.....	.....	.....
69	62	55	21.2	23.2	.....	.....	.....	.....
73	66	59	22.8	24.9	.....	.....	.....	.....

Regardless of the amount of grain theoretically required by a cow, she should not be fed more than she can safely handle.

Example: a cow receiving the usual allowance of good hay and producing 30 pounds of 4.5% milk should be fed 11.2 pounds of concentrates daily.

*Taken by special permission of the Morrison Publishing Co., Ithaca, New York, from the extensive data in "Feeds and Feeding," 22nd Edition, by F. B. Morrison.

TABLE IIIb.

Grain Feeding Table for Cows on Pasture*

Quality of Pasture			Total pounds of grain or concentrates to feed					
			% of fat in milk					
Excellent	Good	Fair	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
Milk produced daily			lb.	lb.	lb.	lb.	lb.	lb.
lb.	lb.	lb.						
22	13	....	.....	.....	.....	.....	.....	1.2
26	17	...	.....	.....	1.9	2.2	3.1	3.5
30	21	12	2.0	2.4	3.8	4.2	5.3	5.7
34	25	16	3.6	4.2	5.6	6.2	7.4	8.0
38	29	20	5.2	5.9	7.5	8.2	9.5	10.2
42	33	24	6.8	7.6	9.3	10.2	11.6	12.5
46	37	28	8.4	9.3	11.2	12.2	13.7	14.7
50	41	32	10.0	11.1	13.1	14.2	15.8	17.0
54	45	36	11.6	12.8	14.9	16.1	18.0	19.2
58	49	40	13.2	14.5	16.8	18.1	20.1	21.5
62	53	44	14.8	16.3	18.7	20.1	22.2	23.7
66	57	48	16.4	18.0	20.5	22.1	.....	.....
70	61	52	18.0	19.7	22.4	.....	.....	.....
74	65	56	19.6	21.4	.....	.....	.....	.....

Regardless of the amount of grain theoretically required by a cow, she should not be fed more than she can safely handle.

Example: a cow on excellent pasture and producing 30 pounds of 4.5% milk should receive 3.8 pounds concentrates daily.

*Taken by special permission of the Morrison Publishing Co., Ithaca, New York, from the extensive data in "Feeds and Feeding," 22nd Edition, by F. B. Morrison.

Roughages

Comparing pasture, hay and grain, pasture is the cheapest source of feed nutrients, followed by hay and lastly the grains. The districts best adapted to dairying are those which can produce an abundance of hay and pasture crops. The cost of winter rations for cows will be the lowest when they are fed all the hay they will consume plus sufficient of a concentrate mixture to balance the ration.

The production of high quality hay is very important in feeding cows economically. Because cows will eat more hay of good quality, less concentrates need to be fed to balance the ration. Three pounds of hay replaces approximately two pounds of grain. If then, a cow eats 12 pounds more of good quality hay than she would eat of poor quality hay, 8 pounds less grain would be required to meet requirements. Conversely, cows fed poor quality hay eat less of it and therefore require more grain.

Cutting and Grinding Hays Increase Feeding Costs

Dairy cows prefer long hay. Cutting hay in a cutting box or grinding hay in a mill does not increase its nutritive value or palatability. There would be some justification for cutting hay when hay is in short supply and it is necessary to reduce hay wastage. By cutting hay cows can be forced to eat the coarser, less palatable and less nutritious portions of the hay. Slightly more grain is usually required to compensate for the lower amounts of cut hay consumed. The cost of cutting or grinding hay is usually much greater than the savings made by reduced wastage.

Hays Vary in Composition.

Hay when cut at an immature stage contains larger amounts of protein than when more mature. It is also less coarse and is more palatable. It is therefore advisable to cut hays before the crop becomes too ripe, coarse and unpalatable.

The curing of hay affects its feeding value. Too much exposure to sun, leaching by rain, or spoilage by dampness in storage may reduce its value as a feed by as much as one-third.

Legume hays, grass hays and cereal hays differ in their nutrient content. Legume hays are richer in protein and minerals than grass hays. Cereal hays contain the least calcium (lime) and cereal straws are too low in feed value for use in rations of cows in milk. Dairymen should therefore strive to grow the most nutritive hays and to prevent any loss of nutrients during the curing process.

Legume Hays Are the Best.

As a group, legume hays normally contain more protein and

minerals than other hays. They are more palatable, and in addition help to maintain soil fertility and prevent soil erosion.

Alfalfa is recommended as the best of all hays for the feeding of dairy cattle. The high protein and calcium content of alfalfa hay decreases the amount of the higher priced protein and calcium supplements required to balance the ration. When alfalfa of good quality comprises one-half of the roughage, it will provide sufficient protein even in the case of high producing cows. In feeding practice this would mean that the linseed meal and bran could be eliminated from the concentrate mixture.

Alfalfa hay should be reserved for cows producing the most milk, because the nutrient requirement of dry and low producing cows can be obtained from the less nutritious roughages.

Alfalfa is adapted to a wide range of soil types, but it does not thrive on poorly drained soil, nor on soil that does not contain a fair amount of lime. Alfalfa requires a reasonable amount of moisture, and should be grown where there is a fair amount of precipitation or on irrigated land where soil moisture can be regulated. Good yields are secured in years of favorable rainfall and two crops can usually be cut. The first cutting is usually coarser and less nutritious than the second cutting, and contains a lesser amount of digestible crude protein and total digestible nutrients.

Sweet clover is similar in composition to alfalfa, but it makes a much coarser and less palatable hay. Nevertheless, by early cutting and careful curing a good, very suitable hay crop can be produced. Sweet clover is adapted to drier conditions than alfalfa or other legume hay crops. It is a biennial, being used as a cover crop the year of seeding and a hay or pasture crop the following year.

Red clover (Altaswede) is very palatable and relished by dairy cattle of all ages. While it contains only two-thirds the digestible crude protein of alfalfa, it is just as rich in total digestible nutrients. Altaswede clover requires a soil which is well drained, free from alkali, and not too strongly acid. It is adapted to the black and woodland soils, and to the irrigated sections. The Altaswede variety is a perennial, whereas other varieties of red clover are biennials.

Alsike clover is similar to red clover in feeding value, but is not quite as palatable. It is adapted to quite moist conditions and consequently grows well, especially in gray woodland soils and adjacent black soil areas. It will thrive well on the heavier soils and on lighter soils if the moisture conditions are adequate and if sufficient lime is present.

Perennial Grass Hays

The grass hays most common in Alberta are timothy, brome grass, creeping red fescue, crested wheat grass, red top, slender wheatgrass (western rye), and reed canary grass. These hays vary in composition, palatability and other characteristics, thus making them differ in their suitability for dairy cattle. All hays vary greatly in composition according to the stage of maturity at which they are cut. This affects their value in dairy cattle feeding. Each of these hays is adapted to a particular set of conditions, moisture supply being the chief factor which determines the localities in which they will thrive.

Timothy hay, providing it is cut before it reaches the full bloom stage, and is properly cured, can be satisfactorily fed to dairy cattle. It grows best in parts of the province where moisture conditions are good, and on irrigated land. It thrives better on cold wet soils of the heavy types than some of the other grasses, and although it endures considerable drought, it yields poorly under dry conditions. Timothy hay cut before bloom contains about 70% more protein than when cut in full bloom. For dairy cattle feeding it is advisable to cut timothy hay prior to full bloom in order to preserve a larger proportion of its protein as well as its palatability.

Brome grass is one of the more common crops grown for hay and pasture. It is a fairly nutritious hay when cut before becoming coarse and unpalatable and when well cured. Brome is extremely winter hardy and usually yields well. Because brome becomes sodbound, it is not advisable to use it as a hay or pasture crop for too long a time.

Creeping red fescue is grown primarily in pasture mixtures, but has also been found useful when sown with alfalfa as a hay crop.

Slender wheatgrass (western rye) is a native type of bunch grass that makes a fairly nutritious hay for dairy cattle. It is winter hardy and grows wild under limited moisture conditions. Because it is subject to certain root rots to which the wheat plant also is susceptible, it should be seeded in a rotation which will not jeopardize a subsequent wheat crop.

Crested wheat grass is more suitable for the drier districts in the province. It is fairly nutritious and well liked by dairy cattle. Although it can be grown in central and northern Alberta where moisture is more plentiful, other better yielding and more palatable hays should be grown in areas of good rainfall.

Red top hay is as nutritious as most other grass hays, but lacks somewhat in palatability. It grows well in marshy and moist soils and will grow on soils too acid for most other grasses. It is hardy

and will withstand considerable drought. While these facts may favor the growing of red top in certain districts, the growing and feeding of this hay crop is not recommended for dairy cows when other more suitable hays are available.

Reed canary grass is coarse, unpalatable and lacking in feed value. When fed to cows in heavy production, an extra allowance of grain should be fed to offset the lower nutritive value of this hay. This grass can be grown in low-lying areas that are subject to periodic flooding.

Annual Grass Hays

These include the cereal hays such as oat, barley, wheat and rye hays. Early cut cereal hays are relished by cattle. As the crop ripens, the straw becomes coarse, unpalatable, and less digestible. Dairy cows should not be forced to consume the ripened butts of these hays unless hay is extremely scarce. Cereal hays are low in calcium, and mineral supplements should be fed when these hays are the sole roughage. They vary greatly in palatability and nutritive value, depending on the stage of maturity when cut. Cereal hays are usually grown when insufficient quantities of legume or perennial grass hays are available.

Oat (greenfeed) hay is the most commonly grown cereal for hay in central and northern Alberta. The yields are usually good, and when cut early it is relished by dairy cattle. Experiments conducted at the University of Alberta comparing an oat hay-grain-protein supplement ration with an alfalfa-grain ration without protein supplement proved that while milk production could be maintained almost as well with the oat hay ration, the cost of the protein supplements increased the cost above that of the alfalfa hay ration. The oat hay fed was cut in the early dough stage and proved to be worth not more than 60% as much as alfalfa for cows producing over 35 lb. of milk daily. Had the protein supplement not been added to the oat hay ration, the value of oat hay would have been less.

Oat hay cut when green or in the early milk stage, while not yielding as high per acre, is more palatable and has a higher feeding value for cows in milk than hay cut at later stages of maturity. Oat hay cut when almost ripe is more suitable for dry cows.

Barley hay is likewise a palatable and nutritious cereal hay when it is cut green and well cured. There is some objection to the awns which become increasingly detrimental as the barley crop ripens. Awnless barley is a much more suitable hay crop to grow, and is increasing in popularity. Barley hay, while not yielding quite as well as oat hay, is slightly higher in digestible protein and total digestible nutrients.

Cereal Straws

Cereal straws are not recommended for dairy cows in milk as they are less palatable and much lower in feed value than any of the hays. They may be used to a limited extent for dry cows and heifers if a suitable concentrate mixture is fed to keep them in a fair condition of flesh.

Oat and barley straws are the best of the cereal straws. Where there is a shortage of hay these straws may be fed in limited amounts providing additional grain is fed to offset the deficiencies of the straw. Awned barley straw should not be fed as the awns are likely to cause sore mouths.

Wheat and rye straws are the least palatable and lowest in feed value of all straws, and are therefore not recommended as a feed for dairy cattle.

Mixed Hay Crops Are Desirable

The feeding of more than one hay adds variety to the ration and often provides a more suitable supply of feed nutrients. The seeding of mixed hay crops results in greater yields than the growing of separate hay crops, and is a much simpler way of feeding a variety of hays. In these mixed crops it is desirable that at least one grass and one legume be grown, the kinds being carefully chosen to suit the climatic and soil conditions. Often a simple mixture of brome and alfalfa has proven to be a good mixture either for hay or for pasture.

Root Crops and Tubers

Succulent feeds are very palatable and suitable for dairy cattle feeding. Because the cost of producing these crops is relatively high, they are very seldom grown as a crop for the dairy herd except for cows on test, or fitting animals for showing. Occasionally, however, due to a low market price, or danger of spoilage such crops can form an important part of the dairy cow ration.

Silages

Silages are also succulent feeds that are highly desirable for dairy cows during the winter. Silage feeding offers several advantages. Green crops can be stored in a silo in a smaller space and with less loss of feed value than the same crop cured as hay. Weedy crops can be best utilized as ensilage. Under average farm feeding conditions, the addition of ensilage to an otherwise dry ration will usually increase production. However, recent experiments have shown that when a suitable balanced ration is being fed, and when water is available at all times, the addition of ensilage to the ration will produce very little or no increase in production.

Considerable study is also being given to the reduction of ensiling costs and methods for securing silage of high quality. The building of trench silos, the use of new type machinery and the addition of preservatives have given some encouragement for a wider use of silage on the dairy farms of the province.

Oat silage has proven to be an excellent feed for dairy cattle. It is palatable, and mature cows will readily consume from 30 to 40 lb. per day. The oat crop is usually cut in the early dough stage and when ensiled at this stage will usually make good quality silage. However, if cut at earlier stages of maturity, or if the crop contains a large proportion of weeds, the crop may sometimes produce silage of a lower quality. The production of low quality silage can often be prevented by the addition of 40 to 50 lb. of molasses or 70 to 80 lb. of ground barley per ton of crop as it is being ensiled.

The practice at the University of Alberta is to seed a mixture of 10% by weight of barley with the oats. When the oats are at the proper stage for ensiling the barley is fairly ripe. The ripe barley reduces the moisture content and supplies carbohydrates for proper fermentation.

Alfalfa, sweet clover, and grass silages. Because the legumes contain higher amounts of protein, more difficulty is experienced in securing silage of high quality than is the case with grass or cereal crops. In making legume silage the stage of maturity, moisture content, and amount of packing are factors which affect the quality of silage produced. Usually preservatives are added to secure the desired chemical reactions.

Legume - grass mixtures usually make better silages than legumes alone because they are lower in protein and moisture content. Nevertheless, the crop has to be properly ensiled and usually molasses or ground grain is added as a preservative. The less mature the crop and the greater the proportion of legume, the more preservative is required. Usually from 100 to 150 lb. ground barley is added per ton of crop ensiled.

Dairymen should use the best known method in ensiling their crops to ensure the production of ensilage of good quality.

Concentrates

It is impossible for cows producing over 20 to 25 lb. of milk per day to satisfy their nutrient requirement from hay alone or from a mixture of hay and silage. Such animals must receive additional nourishment in concentrated form from feeds having a low fiber content and high nutritive value. This concentrate feed must also provide the nutrients which may be lacking in the roughage so that the entire ration satisfies all the nutritional requirements

of the animals. While the cereal grains usually comprise the major part of the concentrate mixture, the addition of protein-rich feed by-products, together with certain minerals, is often required to provide a properly balanced ration.

The different grains and feed by-products vary greatly in composition, palatability and in their usefulness for milk production, growth and fattening. A brief comment on a few of the concentrate feeds follows.

Cereal Grains.

All the cereal grains are carbonaceous and the addition of some protein supplement is necessary when grass or cereal hays are being fed. The grains are low in calcium, and for this reason mineral supplements are usually fed to the heavy producing cows. The grains should be coarsely ground or crushed.

Oats are excellent as a feed for dairy cattle of all ages. They contain slightly less digestible protein than barley and appreciably less total digestible nutrients. Oats also have a higher fiber content. Oats are often used to lighten concentrate mixtures containing the heavier grains and feed by-products.

Barley is a very suitable grain for dairy cattle feeding. It is palatable and usually contains slightly more total feed nutrients than oats. Barley is a heavier grain and tends to be fattening when fed in too large a quantity. However, when fed with suitable other feeds it has proven to be quite satisfactory for cows in milk.

Wheat is not as suitable as oats or barley for feeding cows in milk. It is still less suitable as a feed for young stock. Wheat is much heavier and may cause digestive disorders. Nevertheless it has been fed successfully as the sole concentrate by some dairymen to cows of average production. In experiments at the University of Alberta, concentrate mixtures containing 60% wheat have proven as good as concentrate mixtures containing no wheat. Usually the price of wheat is high compared to the other grains, in which case its feeding is an uneconomical practice.

Rye is the least suitable of the cereal grains for dairy cattle. While its nutritive value may be equal to that of the other grains, it is less palatable, and cows requiring a heavy grain allowance may refuse to consume sufficient quantities if the proportion of rye is too large.

By-product Concentrates.

These vary greatly in composition and suitability. Some are rich in protein and are most useful as a supplement to carbonaceous feeds. Other by-products are carbonaceous and have to be fed with

protein-rich feeds. None of the following feeds is used as the sole concentrate, but only forms a part of the concentrate mixture. Because the by-products vary in price, their purchase should be based largely upon their composition and feed value.

Beet pulp is a carbonaceous by-product of the sugar beet refineries. It is a bulky feed containing a fair amount of fiber. It is slightly laxative and has the effect of maintaining the appetite of heavily fed test cows. Refineries also produce a dried beet pulp to which molasses has been added. This is called molasses beet pulp and is similar to oats in feeding value.

Beet molasses is definitely a carbonaceous feed, a by-product of sugar beet refineries. Its feeding value is dependent upon its sugar content, which makes beet molasses a very palatable feed. Experiments have shown that, pound for pound, it is worth 80% as much as oats in nutritive value. This figure can be used to calculate how much one can afford to pay for molasses as a feed. Sometimes it is used to increase the consumption of less palatable feeds. In such cases molasses is diluted with two parts of water and poured over the unpalatable feed, usually a roughage. Molasses has proven to be a cheap feed in areas surrounding a sugar refinery, but freight charges to distant points may increase the total cost to such an extent as to make its use uneconomical.

Brewers' grains are sold either as wet or as dried brewers' grains. They are rich in protein. On a dry matter basis brewers' grains contain over 40% more digestible protein than wheat bran. In total digestible nutrients brewers' grains are about equal to oats and wheat bran. Wet brewers' grains contain about 75% moisture. Special arrangements have to be made for holding and feeding the wet grains. They may become sour during warm weather when held too long. Up to about 30 lb. can be fed daily. About 4 lb. of wet grains are equal to 1 lb. of dried grains. The dried brewers' grains are not very palatable and are usually mixed with other more palatable concentrates. Good results are secured when the concentrate mixture contains not more than one-third dried brewers' grains.

Flaxseed is grown chiefly for the linseed oil it contains. After the oil has been extracted, the residue is available as linseed meal, which contains approximately 50% more digestible protein than flaxseed. Flaxseed is, therefore, less valuable as a protein supplement than linseed meal. Flaxseed meal is most valuable when fed to young stock to promote normal growth and thrift. It has a laxative effect and acts as an aid to digestion. Because it has the effect of adding a sleekness and bloom to the appearance of animals, flaxseed meal is used by breeders of purebred stock, and by show-

men for these special properties rather than for its nutritive value. In years of normal feed prices, flaxseed meal is usually more expensive than linseed meal, and dairymen would be advised to sell their flax and purchase the linseed meal derived from it.

Linseed meal—the by-product of flaxseed after the oil has been extracted—is one of the most suitable protein-rich supplements for milk production. As previously mentioned, it contains about 50% more digestible protein than flax and over three times the protein of oats or barley. Linseed meal is palatable and has a desirable laxative effect, which helps in maintaining the animals in good thrift.

Soybean oil meal is the residue of soybeans after the oil has been extracted. It is a protein-rich concentrate, usually containing slightly more protein than linseed meal. It is an excellent protein supplement for dairy cows in milk.

Meat meal or meat scraps is the richest protein supplement used in dairy cattle feeding, and therefore less is required to balance carbonaceous feeds. Cows usually do not like meat scraps at first, but if small quantities are fed the amounts can be increased to the full allowance desired. Certain batches of meat scraps may prove more unpalatable than others.

Wheat bran is probably the most widely used protein-rich supplement in dairy cattle feeding. While it only contains about 47% as much protein as linseed meal, wheat bran has proven of special value for purposes other than its protein content. It is especially useful in lightening concentrate mixtures and during periods when there is danger of digestive disorders. The feeding of warm bran mashes before and after calving is highly recommended for maintaining health during this critical period. Wheat bran appears to have the effect of stimulating milk secretion and possesses a higher feeding value than is indicated by its digestible nutrient content. It contains large amounts of phosphorus and vitamins that are required by both growing and lactating animals. Wheat bran is also an excellent feed for calves and heifers.

Wheat screenings are suitable for dairy cattle feeding providing they are low in fiber and do not contain large quantities of small weed seeds. Their feeding value is indicated largely by their weight per bushel. Recleaned screenings are more suitable for cows in milk because they are lower in fiber and higher in total digestible nutrients than uncleaned screenings that contain larger amounts of chaff. The uncleaned screenings can be satisfactorily fed to dry cows and yearling heifers. Wheat screenings should always be ground finely to kill weed seeds.

Wheat standard middlings or shorts are suitable dairy cattle feeds if not forming too large a part of the concentrate mixture. While these feeds contain fair amounts of protein, experiments have shown that they are not as suitable as wheat bran for feeding cows in milk. Wheat middlings or shorts are much heavier than bran, and should not be used in an otherwise heavy concentrate mixture. When prices for these by-products are below the price of bran, they can be used in small amounts to lower the cost of the ration.

Commercial Protein and Mineral Supplements

During the past few years there has been a considerable increase in the sale of commercial mixed feeds in the western provinces. These feeds usually contain a variety of feed by-products that are often unavailable to dairymen in small quantities. Because coarse grains are readily available on most farms, dairymen prefer to purchase protein and mineral supplement mixtures that can be mixed with a prescribed quantity of ground coarse grains. (See page 28).

The value of such protein-mineral supplements to the dairymen is dependent largely upon the amount and kind of protein and mineral supplements they contain. Supplements with the higher protein content are worth more than those with less protein because a larger proportion of the coarse grains can be used to obtain the desired mixture for feeding the herd.

The decision as to whether to buy commercial protein and mineral supplement or to buy the necessary supplements for mixing with home-grown grains depends upon the availability of the supplements, relative price, convenience, labor and mixing facilities available.

All commercial feeds are sold under the Canada Feeding Stuffs Act which requires all sacks of commercial feeds to show a guaranteed analysis and a list of the ingredients.

Minerals for Dairy Cattle

A good dairy cow requires relatively large quantities of minerals to satisfy the combined needs for milk production, growth, reproduction and maintenance. When rations containing a fair variety of feeds are fed, there are only four minerals that are likely to be deficient, i.e. common salt, iodine, calcium (lime), and phosphorus. There is very little possibility of other minerals being lacking except under very unusual feed conditions.

Common salt (sodium chloride).—The feeds commonly used in dairy rations do not contain salt, and for this reason it has to be fed to all animals. It is a mineral that can be self-fed without

danger of overfeeding, but certain cows occasionally may not eat sufficient to take care of their requirements. It is, therefore, a good practice to add 1 lb. of salt to each 100 lb. of concentrate mixture. This insures that the heavy producing cows with the highest salt requirements will consume the most salt. Even when salt is fed with grain at this rate, additional amounts should be made available by allowing the cattle access to either a box of loose salt or to block salt.

Iodine may also be lacking in dairy rations. Serious losses due to iodine deficiency have occurred among newborn animals in most parts of Alberta. Iodine deficiency in dairy cattle is indicated generally by the birth of calves that show one or more of the following symptoms—soft and flabby, goitred (big neck) and partially hairless. In many cases the calf is born dead or dies within a few days of birth.

Iodine is most conveniently supplied in the form of iodized salt which contains sufficient iodine to meet the needs of most dairy animals when they have free access to it throughout the year. Iodized salt is recommended for use in the grain mixture as suggested previously. Iodized salt blocks can also be used to supplement that added to the grain mixture.

Calcium (lime) is lacking only in certain kinds of rations and in cows producing the larger amounts of milk. Rations most likely to lack calcium are those containing no legume hay. The grass hays and especially the cereal hays are fairly low in calcium, and the cereal grains that comprise the major portion of our concentrate mixtures are very low in this mineral.

Cows producing small quantities of milk can secure enough calcium from non-leguminous rations to meet their requirements. Heavy producing cows require more calcium than that contained in the average non-leguminous rations. It is true that animals store calcium in their bones and can use a large proportion of it to carry them over short periods of calcium shortages. It is, however, not good practice to force cows to use their bone calcium, as serious consequences may follow if too much is taken from their bones.

The best practice is to make certain that cows get sufficient calcium in their rations. The cheapest and surest way is to feed legume hays, as these contain ample calcium for the needs of all cows even if legumes comprise only half the roughage allowance.

When legume hays are not fed, a dairyman has the choice of feeding slaked lime or limestone. Bone meal, dicalcium phosphate or Curacao phosphate can be used when both calcium and phosphorus are needed. The best way to feed these supplements is

to add 1 or 2% to the grain mixture, the higher amount being used when cereal hays are fed as well as when the cows are producing most heavily. Additional amounts can be fed by placing a box in the barn yard containing either the supplement alone or mixed with an equal amount of salt.

Phosphorus is very seldom lacking when cows are being fed suitable rations containing good quality hays and grain. Phosphorus is most likely to be lacking in the hays grown on phosphorus-deficient soils. While legume hays contain more phosphorus than other hays, they may not contain enough to provide the required amounts.

Grains, and especially wheat bran, are rich in phosphorus, and cows fed a few pounds or more daily of a good concentrate mixture will receive ample. Phosphorus deficiency will therefore occur only when the cattle are receiving almost their entire ration in the form of roughage. As this practice is not recommended there is little possibility of a phosphorus deficiency occurring. When there is likely to be a phorphorus deficiency, however, bone meal, dicalcium phosphate or Curacao phosphate, if fed as prescribed under the discussion of calcium, will provide ample quantities of both minerals.

Commercial mineral mixtures vary in composition and in price. Some mixtures are composed mainly of the minerals commonly deficient in dairy rations while other mixtures contain additional minerals that are not usually deficient. Mineral mixtures vary in the relative amounts of calcium and phosphorus that they contain. Since calcium supplements such as limestone are much cheaper than phosphorus supplements, many of the mineral mixtures contain relatively high amounts of calcium and would not be suitable or economical to use when phosphorus is the mineral most needed. Dairymen are advised to buy mineral supplements that supply the minerals most likely to be deficient in the rations fed.

Vitamins for Dairy Cattle

Recent research has shown that dairy cattle usually do not suffer from vitamin deficiencies when good rations are fed. Deficiencies of one or two of the vitamins may occur in stock that are not properly fed. Some of the vitamins are of special interest because they occur in milk and are important in human nutrition. A few of the more important vitamins will be discussed in relation to normal nutrition or milk composition.

Vitamin A is essential for growth, health and reproduction and helps to prevent infections of the mucous membranes of the respiratory and digestive systems. Carotene, a color pigment found

in the green leaves of plants, is the original source of vitamin A in animals. Vitamin A is colorless. When cows are on green pasture, their milk is richer in color and higher in vitamin A than when fed on the usual winter rations of hay and grain.

Since carotene and vitamin A are destroyed by oxidation, freshly cut hay when exposed to the sun and rain loses part of its vitamin A potency. It is also true that hay stored in the mow may lose most of its vitamin A before spring. Dairy cows fed old, colorless hay for prolonged periods may develop symptoms of a vitamin A deficiency. The lack of this vitamin may result in diarrhea and slow growth in calves and in the case of cows, lowered fertility and birth of weak calves. Inflammation of the eyelids sore, watery eyes, sensitivity to light and blindness are other symptoms of a vitamin A deficiency.

Vitamin B, originally considered to be a single vitamin, is now known to consist of several separate vitamins including thiamin, riboflavin and nicotinic acid. While these are known to be deficient in rations for other classes of animals, they are not a problem in rations for dairy cattle. It may be mentioned, however, that nicotinic acid has been used to control scours in newborn calves.

Vitamin C (ascorbic acid) prevents scurvy in man. It is not important in the feeding of farm animals because it has been shown that they are able to build up ascorbic acid from other substances in their feed. Some recent experiments have proven that the injection of ascorbic acid has improved the activity and fertility of certain slow breeding and low fertility bulls, and has also increased the fertility of cows.

Vitamin D is known as the "sunshine" or anti-rachitic vitamin. It is this vitamin that enables animals to utilize calcium and phosphorus. The need for vitamin D is high during periods of growth and it is therefore important in the feeding of calves to prevent the development of rickets. It is also important during pregnancy for the normal bone development in the unborn calf, and during lactation because milk contains relatively large amounts of calcium and phosphorus.

Growing plants contain little or no vitamin D, but do contain a substance known as ergosterol, which is changed to vitamin D by exposure to sunlight or ultra violet light rays. Therefore only hays that have been exposed to sunshine can be regarded as good sources of vitamin D. Grains, roots and tubers contain no vitamin D. Dairy cattle usually receive their vitamin D from sun-cured hay as well as by their exposure to sunshine. Summer sunshine is more effective than that of the winter months in changing certain sterols in the animal tissues to vitamin D.

Milk varies in its vitamin D content according to the amounts of vitamin D in the ration and in accordance with the extent of the animal's exposure to sunshine. Summer milk contains more vitamin D than winter milk. Considerable interest has been shown in the production of milk that is rich in vitamin D. Feeding cows cod liver oil or other fish oils rich in vitamin D has been tried, but has resulted in a decrease in fat production and other undesirable effects. The feeding of irradiated yeast to cows has resulted in a considerable increase in the vitamin D content of milk. Irradiating milk with ultra violet light and adding a vitamin-rich concentrate directly to the milk are the usual methods employed in producing milk rich in vitamin D. These practices are, however, only justified when a special demand develops or when special marketing arrangements can be made.

Vitamin E is a nutrient associated with reproduction. All natural feeds contain this vitamin, and it is especially rich in the germ of seeds. There is little possibility of sterility in dairy cattle arising as a result of vitamin E deficiency when they are receiving a ration of reasonable variety and quality. While the feeding of wheat germ oil rich in vitamin E for improving the fertility of cows and bulls has met with some degree of success, the improvement may possibly have been derived from constituents other than vitamin E.

Certain other vitamins have been isolated but it has not yet been shown that they are important in the feeding of dairy cattle.

Water Requirements

The amount of water required by cows is influenced by their size, milk production, kind and amount of feed fed, as well as by the temperature of the air. The results of experiments conducted at the University of Alberta show that dairy cows consumed between 3½ and 4½ gallons of water for each gallon of milk produced. Amounts up to 20 gallons of water daily were consumed by the heaviest producing cows.

Cows will consume more water if allowed free access to it at all times than if allowed water only once or twice daily. Then too, they will consume more water when it is not too cold and when they are not exposed to extremely cold temperatures or unfavorable weather. In connection with the University of Alberta experiments already mentioned, when cows had access to water at all times they consumed almost 8% more water and produced about 6% more milk than cows watered twice daily. While a watering system in the barn is much better than outdoor watering, it is not essential to have individual water bowls for the cows if

some other system can be devised to allow cows access to water more often than twice daily.

Cows will drink more water after eating grain and hay than at any other time. The feeding of ensilage or other succulent feed is beneficial mainly because such feeds are palatable and contain large amounts of water — not because they possess any special nutritive value. If water is not available in the barn, the outdoor water troughs should be sheltered from prevailing winds and a water heater used to raise the temperature of the water high enough to enable cows to consume a maximum quantity.

Summer Feeding

Pasture is the ideal feed.

Pasture is the natural feed for cattle. As has been mentioned already, it furnishes an ideal feed for the dairy cow at a lower price than any other feed. Pasture grasses supply nutrients of the right kind for growth, pregnancy and milk production. The immature grasses are more palatable, and they contain more protein, minerals and vitamins than the same plants when more mature.

Pasture provides the cheapest feed.

Pasture yields vary according to the type of soil and kind of plants grown, as well as with moisture and temperature conditions during the growing season. The tonnage yield of pasture is greater and more nutritious than the hay crop, and an acre of pasture will produce more milk and butterfat than the same crop cut and fed as hay. In addition, the cow will do a much more economical job of harvesting than when the crop is cut and stored as hay.

Pasture alone is insufficient for high producing cows.

When cows are on good pasture, they can consume enough grass to maintain themselves and produce about ¾ lb. of butterfat daily. This means that in the case of cows producing not more than 20 lb. to 25 lb. of milk, good pasture will take care of their requirements. Supplementary concentrate mixtures are necessary to meet the needs of cows producing more than these amounts. The cows will not only maintain production at a higher level during the pasture season, but will maintain that higher level after the pasture season has ended.

Feeding concentrates to cows on pasture is a profitable practice when grain prices are normal in relation to the price received for milk or butterfat. When feed prices are relatively high or the prices of dairy products are relatively low, the profitability of grain feeding becomes less. The amounts of grain to feed cows on pasture are shown in Table IIIb on page 29.

The concentrate mixture fed to cows on good pasture can be carbonaceous, consisting only of ground oats or barley, because the pasture grass consumed will provide the necessary protein as well as minerals, except salt.

Milk production during the fall can be maintained.

During the latter part of the summer and early fall the growth of pasture is retarded and fails to provide as much feed as during the late spring and early summer. As the pasture growth declines, it becomes difficult or impossible for the cows to obtain sufficient pasture for a good fill. Milk production will decrease under these conditions unless extra feed is provided to offset the pasture shortage. This extra feed can be provided either in the form of freshly cut hay crops, silage, increased grain allowance, or by providing supplementary annual pasture such as oat cover crop.

Providing ample pasture is profitable.

Because pastures provide the cheapest source of food, ample pasture should always be provided. On most dairy farms native pasture on land unsuited for cultivation is insufficient to meet the needs of the dairy herd, and cultivated pasture crops must be seeded. Crops suitable for pasture vary in yield as well as the length of growing season. Less pasture land is required when the heavier yielding and longer growing pasture crops are provided.

Perennial grass pasture crops.

Most grass crops that make suitable pastures can also be cut for hay. Such grasses as timothy, brome, slender wheatgrass (western rye), creeping red fescue, red top, crested wheat, Kentucky blue and reed canary grass can be used alone or in mixed pasture under conditions most suitable for their growth.

Legume pastures.

Legume crops provide more forage than grass crops but pure stands are seldom used for pasture because of the danger of bloat.

Alfalfa is both highly palatable and nutritive, but cattle pastured on this crop are more subject to bloat than on any other single pasture crop. The danger from bloat can be lessened in several ways: (1) by turning cows on the alfalfa pasture after they have eaten a feed of hay, or (2) after they have just previously been foraging on a grass field, (3) by not turning cows on alfalfa pasture which is moist with dew, nor (4) on to pasture of recent seeding—it is best to pasture on an older crop that has been cut for hay for two or more years, (5) by growing an alfalfa-grass pasture mixture. Alfalfa can be pastured much more safely when it com-

prises only part of the pasture mixture. The grass content of these mixtures greatly reduces the danger of bloat.

Sweet clover pasture may not be as palatable as alfalfa until cows have become accustomed to it. It may cause bloat during the first year of growth, but rarely causes bloat the second year except early in the spring when making the most vigorous growth. It is a difficult crop to pasture evenly, and portions of the field usually grow rank and coarse. On irrigated pasture this can be controlled by clipping and proper irrigation.

Red clover (Altaswede) pasture is very suitable for a dairy pasture. There is not as much danger of bloat as in the case of alfalfa, but the same precautions against bloat should be taken. Red clover is best used in a legume-grass pasture mixture.

Pasture mixtures are the best.

They furnish more forage than the single crop pastures and provide a longer pasture season. Mixed pastures should contain both legume and grass plants most suited to the soil condition as discussed previously under the individual hays. (See pages 30 to 34). Some pasture mixtures make excellent hay crops, and the practice of utilizing the crop for hay for a year or more after seeding before using it for pasture has proven to be satisfactory for a rotational scheme. The heavier yields of these mixed pastures reduce the land required for pasture and allow more land to be used for other crops.

Suggested Pasture or Hay Mixtures

In seeding a mixed pasture it is well to consider using one which could also be used as a hay crop for one or two years before being used as a pasture.

The Alberta Forage Crops Advisory Committee has recommended the following:

No. 1.	Alfalfa	3 lb. per acre	For all but the drier parts of the province.
	Brome	6 lb. per acre	
	Creeping Red Fescue	3 lb. per acre	
2.	Alfalfa	3 lb. per acre	Semi-dry areas.
	Brome	5 lb. per acre	
	Crested Wheat	3 lb. per acre	
3.	Alsike	2 lb. per acre	Suited to wet locations subject to flooding.
	Reed Canary	5 lb. per acre	
4.	Alsike	2 lb. per acre	For acid soils subject to flooding.
	Red Top	5 lb. per acre	

Supplementary Pasture Crops

Before the main dairy pasture can be used in the spring and after it ceases to provide ample forage in the fall, cows must be either barn fed or placed upon a supplementary pasture. The seeding of special crops has proven the cheaper and most satisfactory method of feeding the herd during these periods.

Oat pasture can be seeded early or late to provide either the main pasture or late supplementary pasture. When used as the main pasture it does not provide as early a pasture as do the perennial grasses. Oat pasture has a fair carrying capacity, but does not have a long growing season. For a supplementary pasture oats can be seeded at the rate of 2¾ bushels per acre late in July on well prepared land, and under suitable conditions will provide four to six weeks of pasture after the regular pasture has been finished.

Fall rye is the earliest spring crop, but supplies pasture only for a short period. In the spring it is used only until the other pastures are ready, and then plowed up and re-seeded the same year to a late sown crop. It is possible to pasture fall rye during the autumn of the year it is sown if precaution is taken not to overgraze.

Rape pasture may be used for young stock and dry cows. There is, however, some tendency to bloat when cattle are pastured on wet rape. It is quite laxative and therefore is usually not fed as the sole pasture. Milk from cows on rape pasture has a disagreeable flavor. For these reasons rape is not recommended as a suitable pasture for the dairy herd.

Feed and Care of Cow at Calving Time

Calving time is a critical period in the life of a cow, and her feeding and care during this period have a great deal to do with her subsequent milk production. At parturition her whole system changes from that of pregnancy to lactation. Before a cow calves, the feed she eats is used to nourish the embryo and to build up her own tissues in preparation for the coming lactation period. No milk is being produced and her nutrient needs are therefore mostly carbonaceous and relatively small. But after calving she begins to secrete large quantities of milk which necessitates large quantities of energy, protein and minerals. Failure to provide these nutrients results in a depletion of the cow's body reserves followed by a reduction in milk flow.

A great deal can be done to aid the cow in making this drastic change in function. She should receive mild, laxative feeds prior to calving to assist her during parturition. There should be a reduction in the amount of concentrate fed so as to avoid digestive dis-

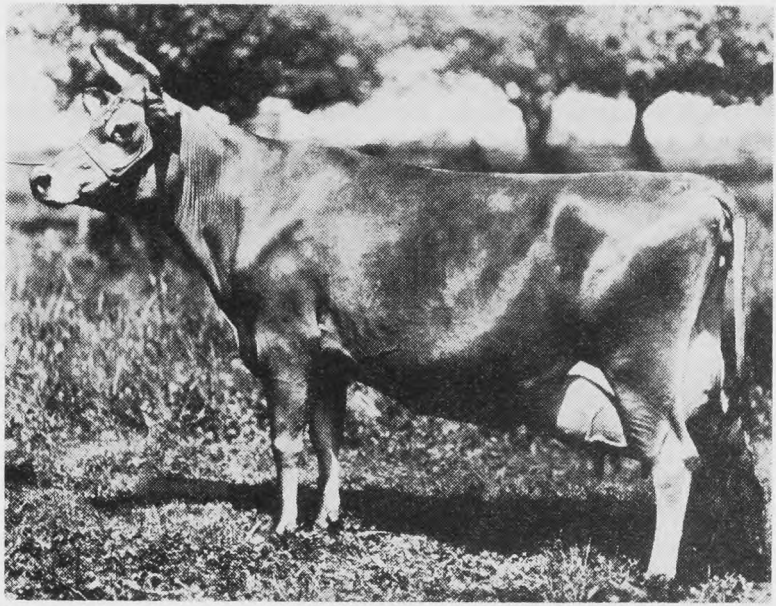

Fig. 8—The world's highest producing Jersey, Brampton Basilua, imported and owned by B. H. Bull & Sons, Brampton, Ontario, with 5-year-old record of 19,012 pounds of milk and 1,313 pounds of butterfat.

orders and to stop the tendency to put on flesh. She should be offered warm water often to meet her increased water requirement. For a day or two prior to calving it is good practice to feed warm bran mashes of 3 or 4 lb. twice daily and to allow her to consume the usual amount of good quality hay.

Following calving, warm bran mashes should be continued for about two days to help stimulate milk production and aid in the expulsion of the afterbirth. If the udder continues to be inflamed and "caked", the bran mashes should be continued for a longer period. After the udder becomes nearly normal, the bran should be gradually replaced by small amounts of the herd concentrate mixture. Cows should not be fed a full grain allowance until three weeks or longer after calving if the udder continues to be inflamed.

When udders become seriously inflamed and congested before calving some relief can be given by milking regularly and completely prior to calving. The only problem arising from milking cows before calving is that there may be no colostrum for the calf. This can be offset by either freezing the milk obtained before calving for later use, or by adding vitamin A to the milk produced after calving. Some Jersey breeders claim that the premilking of heifers reduces the danger of udder damage caused by excessive inflammation.

Cows that are to calve should be placed in a clean box stall and allowed to care for their calves as soon as they are dropped. Cleanliness at this time is important for the health of the calf, and as a means of protecting the herd in case there has been an abortion. In the latter case the dead calf and the afterbirth should be carefully removed and burned, and the box stall again disinfected.

A mature cow in good condition will usually expel her calf without any assistance. However, some assistance may be necessary for young heifers and for cows that are weak, overly fat, or that fail to develop normally in their pelvic area. When the calf is being presented in an abnormal position it is often possible to manipulate it into normal position to facilitate expulsion.

The cow should not be completely milked out for two or three days as there may be some danger of milk fever developing in a high producing cow. Leaving the calf with the cow during the first few days helps to remove congestion in the udder. The cow should be milked to prevent too much accumulation of milk in the udder, but not all of the milk should be removed until the udder is well on the way to becoming normal.

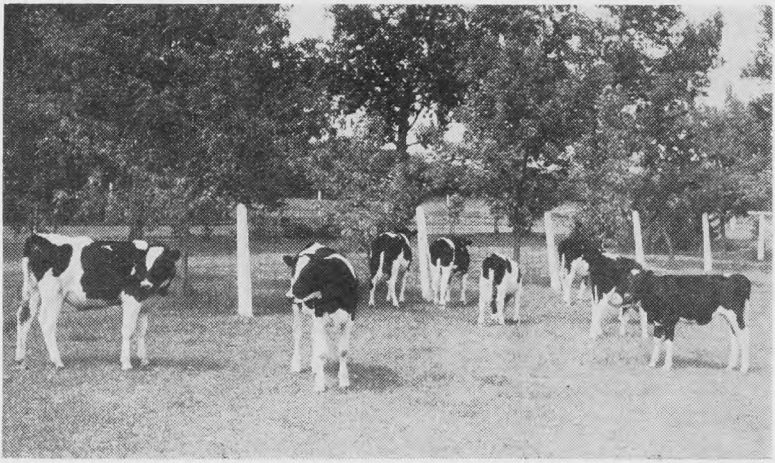

Fig. 9—Calves of today are the milking cows of tomorrow.

If the calf is taken from the cow soon after it is born, the cow has to be milked several times daily to obtain the colostrum milk so necessary for the well-being of the newborn calf. If the udder is congested it should be massaged, given heat applications or otherwise treated to remove the inflammation. Some dairymen believe that when the calf is taken from the cow soon after birth it is easier to train the cow for the normal milking procedure and to teach the calf to drink from a pail.

It is important to treat cows with kindness during parturition. Cows handled quietly and gently will allow the attendant to give any necessary assistance during parturition and can be quickly induced to let down their milk.

Raising the Calf

In average herds approximately one-quarter of the cow herd has to be replaced annually. The heifers retained must be as good or better than the cows if the herd production is to be maintained or increased. If the herd sire has been well chosen, the calves born in the herd should be an improvement on their dams. While replacements can often be purchased at low prices there is some speculation as to their milk producing ability, freedom from disease, or abnormal hereditary traits. Raising heifer calves out of the best cows in the herd and sired by a good purebred bull is the surest way to obtain satisfactory replacements.

Raising calves properly is as important as the feeding and care of the milking herd. Calves are born with an inherent milk producing possibility, which becomes a reality only when they are reared under conditions most favorable to the full development of all parts of the body. Stunting from inadequate feed, ill-health or improper care reduces the future milk producing possibilities of the heifer.

Calves should get the right start.

It is most important that calves get well started in life. The dairyman should make sure that the calf begins to breathe properly as soon as it is dropped by making certain that the fetal covering is not over the nostrils. The cow should be allowed to lick the calf dry. Tincture of iodine should be applied to the navel as soon as the calf is born to prevent infection. If the calf has not suckled within a few hours, assistance should be given to make sure the calf receives the colostrum milk. This milk is essential to stimulate the digestive tract. It acts as a laxative and contains vitamins and minerals necessary for growth and prevents calfhood infections and diseases. In case the mother dies, the addition of vitamin A to normal milk has been found to be a fair substitute for the colostrum milk. If the cow's milk is too rich in fat, it may result in scours. In such cases the calf should be taken from the cow and fed a limited amount of the same milk diluted with water.

The first three weeks.

The calf should always be fed its own mother's milk until one week of age. The milk that is fed during the first three weeks should be warm. Extreme patience should be exercised in teaching

a calf to drink milk from a pail. Quite often calves will drink too rapidly and develop digestive ailments. Nipple pails or other devices can be used to induce the calf to drink slowly. It is necessary to feed only a pound of milk daily for every ten pounds of live weight. Small Jersey calves require six or seven pounds, while a one hundred pound Holstein calf would require ten pounds of milk daily. Scours are sometimes caused by the calves drinking too much milk that is too rich. The milk allowance should not be increased above the amounts mentioned above, and at no time is it necessary to feed more than twelve pounds daily. It is essential that the milk pail be thoroughly washed after each feeding, as disease bacteria multiply very rapidly in dirty utensils.

Calves will begin to nibble at grain when they are ten to fourteen days old. Small handfuls of coarsely ground oats can then be thrown into the empty milk pail as soon as the milk has been drunk. After the calf has learned to eat grain, it can be self-fed without danger of over-feeding for several months. Up to three weeks of age calves will eat very little hay, but it is a good practice to allow them to eat as much hay of good quality as they desire.

Three weeks to four months of age.

This should be the period of skimmilk feeding. If skimmilk is not available, whole milk feeding should be continued. The change from whole milk feeding to skimmilk feeding should be gradual and take approximately a week's time, as any sudden change in feeding will cause digestive ailments. The feeding is very important during this period because considerable amounts of protein and minerals are still required. However, there is no advantage in feeding large quantities of skimmilk, 12 lb. daily usually being sufficient to supplement the hay and grain part of the ration.

A satisfactory concentrate for calves of this age can be ground oats alone or a mixture of equal parts oats and barley. It may be self-fed until 3 lb. of grain is being consumed daily without danger of over-feeding. Calves, however, will not require more than 3 lb. of concentrates while receiving skimmilk. The feeding of good quality hay should be continued and calves should be allowed to eat as much as they desire. The consumption of hay should be encouraged to aid in the development of a good digestive system.

In the summer calves of this age cannot consume enough grass to equal hay and grain feeding. It is best to place the calves in a small grass paddock. Skimmilk and grain should always be fed while the calves are on pasture, and they should also have access to some hay.

Water should also be provided, as the skimmilk fed does not satisfy the water requirement. This fact is sometimes forgotten when calves are young and kept in the barn.

Four months to one year of age.

During this period there is continued rapid growth and the nutrient requirement is fairly high. Skimmilk feeding may be discontinued at four months of age if good quality hay and a suitable concentrate mixture are fed. Protein and minerals should be added to the grain mixture to partially replace those previously supplied in the skimmilk. If only grass hays are available a concentrate mixture with 20% wheat bran or 10% linseed meal would be more suitable than grain alone. The concentrate mixture should also contain 2% bone meal and 1% iodized salt. The amount of concentrate mixture to feed daily depends upon the condition of the calf. Between two and four pounds of concentrates are usually required to keep the calf in fair condition and growing vigorously. There is no advantage in feeding dairy calves so that they carry excess flesh. Heifers should be fed so they develop the ability to consume large roughage allowances rather than the more expensive concentrate mixtures.

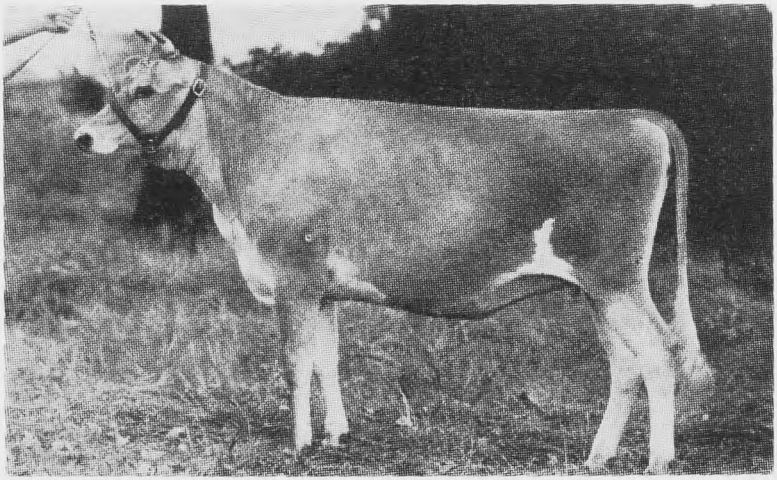

Fig. 10—Only heifers well raised become profitable cows.

The hay fed should be of good quality to help replace some vitamins and minerals that had been supplied in the skimmilk. It is of particular importance that the hay be green as a deficiency of vitamin A may develop. Alfalfa hay is ideal for young heifers. It contains sufficient protein, minerals and vitamins to make it

unnecessary to add protein-rich supplements or minerals to the grain mixture.

Pasture grass is also ideal, but will not provide ample nutrients to meet all requirements. Grain feeding must be continued while the calves are on pasture, but the addition of protein-rich supplements and minerals to the grain mixture is unnecessary.

Yearling heifers.

Year-old heifers are usually not difficult to feed as their protein and mineral requirements have become less. Usually these heifers can make normal growth on legume hay of good quality with a very limited amount of grain. The heavy feeding of roughage with limited grain feeding helps to develop a good framework and large barrel, a necessity for high production. Since good quality hay or luxurious pastures may not always be available, the feeding of suitable grain and supplements is often necessary. The amounts of these feeds fed should be based upon the condition of flesh and general thrift.

Milk Substitutes and Calf Meals

On farms where whole milk is sold it is impractical to provide skimmilk for calf feeding and it is expensive to continue liberal whole milk feeding till four or six months of age. Some saving can be made by slightly reducing the whole milk allowance below the amount previously mentioned, or by feeding skimmilk substitutes, calf meals or gruels. The feeding of inadequate quantities of milk during the first few weeks or eliminating milk before the calf is able to consume and digest substitute feeds results in the permanent stunting of calves and unthriftiness. Fresh whole or skimmed milk contains nutrients that are ideal for young calves, and as yet a perfect substitute has not been discovered.

There are several ways of successfully raising calves on farms where whole milk is sold: first, by feeding minimum amounts of whole milk properly supplemented with a suitable concentrate mixture and hay; second, by feeding a so-called "milk-substitute", calf meal or gruel.

Numerous experiments have been conducted to determine how early calves can be weaned and how much the daily allowance of skimmilk can be reduced without affecting the growth and thrift of the calves. The answer to these questions was found to be largely dependent upon the suitability of the concentrate mixture and hay fed. In experiments conducted at the University of Alberta it was found that calves could be weaned at four months of age

when receiving the following concentrate mixture with a good quality grass hay and not more than 12 pounds of skimmilk daily:

Oats	38 lb.
Barley	30 lb.
Wheat Bran	30 lb.
Salt	2 lb.

The results of recent experiments conducted elsewhere to find an economical milk substitute feed for very young calves have been encouraging. A few manufacturers are now preparing feeds, commonly called milk replacers, that are suitable for calves three and four days of age when the colostrum ceases to be produced. These milk replacers contain skimmilk powder, fats, molasses, minerals, vitamins, antibiotics and other feed and feed by-products to make the mixture highly nutritious and palatable. Such feeds are fed in liquid form to replace the milk usually fed to calves.

Milk replacers are usually fed until calves are about two months of age. A dry calf meal is fed in addition to the milk replacer, and is usually fed until the calves are four months of age.

A good calf meal should contain from 20 to 23% protein and be rich in total digestible nutrients and low in fiber.

Proteins of animal source such as skimmilk or buttermilk powder, fish meal or meat scraps, are suitable but not essential in formulating a calf meal. Satisfactory calf meals can be made using protein supplements of plant origin such as linseed meal or soybean oil meal.

The following two mixtures are suggested:

35 lb. oat groats	17 lb. oats
10 lb. barley	25 lb. oat groats
5 lb. wheat	15 lb. barley
5 lb. wheat bran	10 lb. skimmilk powder
25 lb. linseed meal	5 lb. wheat bran
10 lb. soybean oil meal	10 lb. linseed meal
7 lb. dehydrated alfalfa meal	15 lb. soybean oil meal
2 lb. bone meal	2 lb. bone meal
1 lb. iodized salt	1 lb. iodized salt
100 lb.	100 lb.

Suitable commercial calf meals are available. Some dairymen prefer these because the individual ingredients are sometimes difficult to buy and labor not available for weighing and mixing.

Full feeding of calf meals is recommended until calves are from 4 to 6 months of age. Simple grain mixtures in amounts required for normal growth can be fed after this age.

Exercise is essential for calves of all ages.

During the winter calves should be allowed the freedom of a small pen in a part of the barn that is well lighted. When the

weather is not too severe they should be outdoors during the day in a pen or yard protected from prevailing winds. Sunshine prevents the development of rickets and aids normal bone growth and development. In the summer the calves should be kept in a grass paddock with some shelter from the hot sun and inclement weather.

Dehorning

Horns on dairy cattle make their handling more difficult and are a source of danger to other cattle and to the dairyman.

The use of caustic potash to remove horns of calves when one or two weeks of age is a more satisfactory method than removing horns of older cattle by sawing or clipping. The caustic potash method is also more easily accomplished and causes the least discomfort to the animal.

Procedure: Remove the hair surrounding the horn button with shears or clippers. Rub moist stick of caustic potash over and around the horn button until the skin ruptures and begins to bleed slightly. When excessive amounts of potash are used, some may run down the face and endanger the eyes. To prevent the spread of potash a ring of vaseline can be applied to the area immediately surrounding the horn button, and the calf isolated from the others and protected from rains.

For dehorning older cattle, dehorning clippers or saws are used. The use of clippers is best for younger animals whose horns are not too heavy or brittle. The horns should be removed as close to the skull as possible to prevent further growth. After bleeding has ceased, disinfectants should be applied that will prevent infection and repel flies. Pine tar is recommended as it will stick to the wound for several days and is a good fly repellent.

Feed and Care of the Dairy Bull

The feeding of the dairy bull is relatively simple, but some thought should be given to the kinds and amounts of feed required to maintain his breeding efficiency. He should be fed as much hay as he will eat without undue waste. The amount of grain to be fed will depend upon his condition of flesh and amount of service. It is desirable to maintain a bull in a thrifty condition by feeding suitable feeds in sufficient quantities. At no time should bulls be allowed to become excessively fat or thin.

The care and management of the dairy bull is of extreme importance because improper care and management may cause a bull to become vicious and difficult to manage. The temperament of a bull is determined by the way he is handled as a calf. He should be halter broken as a calf and taught to recognize man as his

master. A ring should be put through the nose before he is a year old and be changed for stronger ones as he gets older. A strong bull staff should always be used in leading a bull. An additional safety device is a six or seven foot chain with one end looped around the horns and the other end passed through the nose ring. All dairy bulls should be dehorned.

Keep the bull in separate quarters.

The bull should not be allowed to run with the herd, as bulls managed in this way tend to become vicious. The bull should be housed in a separate shed or given a suitable box stall. Outside the shed or box stall there should be an exercising pen and yard where cows can be bred. This arrangement avoids the risk of injury to the attendant. A small grass paddock just outside the exercising pen is excellent for providing succulent forage during the pasture season. The fences holding the bull should be strongly built. The additional use of a single electric fence wire strung inside the bull exercising pen and paddock prolonges the life of the fence and aids in keeping the bull under control.

Exercising the bull is important.

Bulls require plenty of exercise if they are to be kept in a vigorous condition. Various methods have been devised to induce bulls to exercise. An empty barrel or keg on the ground in the bull pen, or a heavy block of wood hung between two posts provides something for the bull to exercise on. When an exercising pen is not available, bulls can be tied to a ring which slides on a cable. Usually these cables are about 100 ft. long and strongly constructed. The lead chain should be attached to the bull ring and be of a length which does not allow the bull to step over.

Service.

The young bull can be used for light service when ten to twelve months of age. Mature bulls can serve three or four cows weekly. Usually one bull if kept in good condition can be used on 80 to 100 cows annually if they are bred to freshen uniformly throughout the year. Overworked bulls become inefficient breeders as the number and vitality of the sperm cells become greatly reduced. Only one service should be given to each cow when the bull is being used regularly. If however, the bull has been idle for ten days or longer, cows should be given two services because the semen in the first service may contain a high proportion of dead sperm cells.

"Safety First" should be practiced by dairymen in all dealings with dairy bulls. Regardless of how quiet and harmless a bull

may appear, experience has proven that no bull can be trusted at all times. In feeding and handling any bull the dairyman should always be on the alert and take no unnecessary chances.

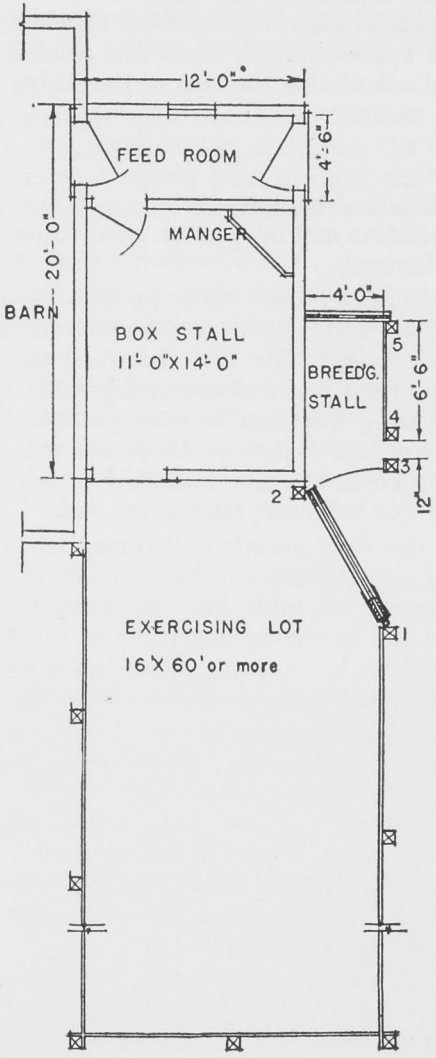

Fig.11—Floor plan of a bull shed, exercising yard, and breeding stall.

The floor plan shows the desired location of the posts numbered in the order in which they should be situated. The stall is 6′6″ long from post 4 to post 5 and 4′ wide. Post 4 is situated 12″ from post 3 so the attendant may facilitate service if necessary. The width of the gate from post 1 to post 2 may vary from 6′ to 8′. The stanchion at the end of the stall is built in a swinging gate which opens to the outside so the cow may be let out.

—Courtesy Illinois Agr. Exp. Sta.

Cost of Producing Milk

The main purpose of determining the cost of milk on any farm is to find out how efficiently milk is being produced. This is done by comparing the individual cost items of one farm with those of another. By such comparisons the most efficient practices can be determined and applied. Milk costs are usually calculated on a yearly basis. In calculating the cost of producing milk, the following charges are made:

1. Feed.
2. Labor.
3. Buildings and equipment.
4. Depreciation and interest on herd values.
5. Miscellaneous.

Feed cost comprises from 40% to 50% of the total cost of producing milk. It will vary from year to year according to fluctuations in feed prices. The fact that feed accounts for such a large proportion of the cost makes possible wide variations in costs between farms using different feeding practices. Feed costs are low when: (1) the less expensive feeds are fed, (2) the cows are not overfed, (3) cows are not underfed to seriously affect milk production, and (4) balanced rations are fed.

Labor costs also vary greatly and range between 30% and 40% of the total cost. Differences in the amount of labor required to produce 100 pounds of milk may be caused by differences in equipment used and in the arrangement of the barn as well as in the efficiency of the labor used. The cost of hauling milk from farm to market is sometimes included under this item.

Building and equipment costs vary from 5% to 15% of total costs, and largely depend upon the value of the dairy barn and milk house as well as equipment. The farmer should charge a reasonable interest on his dairy barn and equipment investment and also should charge depreciation on same. Those dairymen who build unduly expensive barns and buy expensive equipment will have much higher costs for this item than dairymen using less expensive barns and equipment.

Cow charge includes the interest on the investment plus depreciation. This charge usually is only 6% to 8% of the total cost. Cows only average from four to five years' production in a dairy herd, which makes the depreciation charge rather high. This may appear to be a short time, but when it is realized that disease, injuries, sterility and other ailments take a heavy toll, this charge is not too high.

Bull charge is only 3% to 6% of the total cost. It varies likewise according to the value of the animal, and whether or not

the bull will have a higher or lower value when sold. The bull charge for each 100 lb. of milk is necessarily high in small herds because the item will be about the same in a 10-cow herd as in a 50-cow herd. In districts where there is an artificial breeding association, many dairymen have found that they have reduced the cost of bull service by selling their own bull and breeding artificially.

Miscellaneous charges may amount to 20% or 30% depending upon the number of items included, and upon the expense of each. These items include cow testing fees, medical and veterinary fees, dairy magazines, disinfectants, breed association fees, etc.

Production per cow is the greatest factor.

Production can greatly affect the cost of producing milk because the cost items increase at a slower rate than milk production. Thus, as production increases, the cost of producing 100 lb. of milk or a pound of butterfat decreases. Dairymen with high producing herds have a lower cost of production than dairymen with low producing herds. All dairymen should strive to reduce the cost of producing 100 lb. of milk or 1 lb. of fat by increasing the average production of their herds.

Fig. 12—A profitable cow, University Rosebud Pontiac 124830, bred and owned by the University of Alberta. A 20-year-old cow that produced 14 calves and has official records totalling over 180,000 pounds of milk, 7,000 pounds of butterfat.

Increased production per cow can be attained by (1) using better bulls, (2) culling out low producers, (3) feeding more suitable rations, (4) providing sufficient pasture, (5) controlling diseases, and (6) breeding for more early winter freshenings.

Increases in production resulting from improved methods of management are accomplished with little or no increase in cost, thus producing a greater net income.

Increasing labor efficiency.

The labor required to produce each 100 lb. of milk is reduced as the size of the herd increases. This is especially true when small herds are increased to 10 to 12 head, a size considered more suitable for a one-man dairy farm. Providing pastures nearer to the barn, improving barn procedure in feeding and milking, and installing labor-saving devices or equipment are other methods of reducing labor costs.

Combining Other Farm Enterprises with Dairying

Dairymen should be interested in making the greatest total profit from all of the enterprises on the farm rather than from dairying alone. As a general rule on every farm there are certain combinations which will yield greater total net profits than any one enterprise alone. The combination of enterprise established on the farm is likely to be influenced by the aptitudes of the farmer and also by crop yields and economic conditions. In creamery districts the net earnings usually can be increased by keeping hogs or poultry since these make the most efficient use of the skimmilk available. In areas where whole milk is sold, cash crops may prove the most profitable combination with dairying.

Dairying is one of the most intensive of farm enterprises and involves many different kinds of work, each of which has to be efficiently done to make the enterprise profitable.

Milk Secretion and Milking Practices

A knowledge of how milk is secreted is of practical value because it suggests how milking can be most efficiently done. During recent years discoveries have been made that explain how and why certain things happen in the udder of milking cows. There is, however, still a great deal more to be learned about this complex process. From the knowledge available, certain principles for milking cows have been established. By applying these the dairyman can get the most milk at each milking throughout the lactation period.

The normal cow's udder consists of four mammary glands called "quarters". The amount of milk that is secreted depends upon

the size and amount of glandular tissue in the udder. The udder contains innumerable connected ducts or openings of different sizes that hold the milk which has been secreted. The smallest of the openings are microscopic in size and are called alveoli. Each small opening is lined with special cells that take ingredients from the blood and reconstruct them into milk, which is then expelled into the microscopic openings.

Milk is secreted at all times.

Milk is secreted during the entire period between milkings. As proof of this cows have been slaughtered just prior to milking time, their udders have been removed and milked or analyzed for the milk contents. These studies have shown that all milk that would have been expected at normal milking was present in the udder. Milk secretion is most rapid just after milking, and slows down as the glands fill with milk. This accumulation of milk in the udder builds up a pressure which may even rise sufficiently to cause milk secretion to stop.

Milk completely and often to get the most milk.

These facts concerning the rate of milk secretion have a very important bearing on how cows should be milked. Firstly the cows should be completely milked out, because any milk remaining in the udder contributes to pressure which reduces the rate of milk secretion. If cows fail to "let down" their milk, all the milk in the udder cannot be obtained. Secondly, if cows are milked more frequently, more milk will be produced daily, because the pressure will not rise to the same levels and retard milk secretion to the same extent. Some experiments have shown more than 20% increase in milk production for three times a day milking, and more than 30% increase for four times a day milking as compared to twice a day milking. The economy of milking more than twice daily is largely dependent upon the amount of milk the cows produce. Thirdly, the best way to dry off cows is to leave considerable milk in the udder to retard further milk secretion. Some authorities even advocate abruptly ceasing to milk cows in order to dry them most quickly. Fourthly, the effect of udder pressure explains why the inflation of the udder with air is effective in curing milk fever.

How cows "let down" their milk.

The milk in the alveoli and the smaller ducts remains in the udder until it is squeezed out. The muscular contractions that occur at the time of milking explain how cows "let down" their milk. If these muscular contractions do not occur, not all the

milk can be withdrawn, and it is said that the cows "hold up" their milk. Scientists have proven that a hormone secreted by the pituitary gland causes these muscular contractions that force the milk to be released in the udder. When milking first begins, the manipulation of the teat and the warmth of the hands cause the pituitary gland to secrete the hormone (oxytocin) into the blood which, when it reaches the udder, causes the muscular contractions to occur. This results in a rapid rise in udder pressure which remains higher than normal for several minutes. If cows are milked during this higher pressure period all the milk can be obtained.

Other things may cause cows to let down their milk. The regularity of sounds or events that occur just prior to milking may become associated with the milking act and cause the secretion of the hormone responsible for the letdown. Driving cows from pasture, bringing them into the barn, grain feeding, the rattle of pails or the noise of the milking machine may all cause individual cows to let down their milk before milking is started. Such cows should be milked first to take advantage of the increased pressure present.

Rapid milking is recommended.

To get the most milk from cows, milking must be completed during the "letdown" period. Since this period lasts only a few minutes rapid milking is now recommended as the most efficient method. Milking machine companies have improved their machines to enable faster and more efficient milking. When cows are milked slowly most of the milk left in the udder after the extra pressure of the "letdown mechanism" is released cannot be obtained.

Cows can "hold up" their milk.

Cows that are frightened, or distracted from the usual events of milking or barn procedure, may not let down their milk. Allowing a dog to chase the cows, mistreatment, having a different person milk the cows, the presence of strangers in the barn or unusual noises during milking time are a few of the things that may cause sufficient disturbance to prevent the normal secretion of the hormone. Such cows will hold up part of their milk and this in turn acts to retard subsequent milk secretion. Regularity, quietness, kindness in handling the cows are factors which indirectly affect milk production.

Milking machines are not harmful when properly handled.

The latest models of milking machines if properly operated will maintain production at as high levels as the hand milking method and will have no harmful effect on the cow's udder. The proper

operation of a milking machine includes maintenance of mechanical efficiency, the observance of sanitary standards, as well as avoiding harmful practices in the use of the machine on the cows. The cows should be encouraged to let down their milk just before the teat cups are applied to the teats. They should be removed as soon as the milk flow ceases. If machines are allowed to operate when milk has ceased flowing, the result may be injury to the lining of the teat. For best results all milking machines should be operated according to the directions of the manufacturer.

Procedure in Machine Milking.

To machine milk a herd of cows rapidly and efficiently it is necessary to set up and follow a definite procedure. The usual practice for one operator using two milking units is as follows.

1. Stimulate cow A by washing udder with warm disinfectant solution.
2. Stimulate cow B by washing udder with warm disinfectant solution.
3. Attach machine to cow A about 1 minute after stimulation.
4. Attach machine to cow B.
5. Stimulate cow C.
6. Machine strip cow A by pulling down on teat cups and massaging udder.
7. Remove machine from cow A and attach to cow C.
8. Stimulate cow D.
9. Machine strip cow B.
10. Remove machine from cow B and attach to cow D.
11. Continue procedure for the rest of the herd.

Cow Testing

Records kept of the pounds of milk and butterfat produced by each cow enable a dairyman to determine which of his animals are proving the most profitable. Cows of low production due to short lactation periods or low test can be located and culled from the herd. By the use of records, calves from the best producing cows can be retained.

The influence of feed changes can be noted and rations most efficiently utilized by herds can be formulated. The onset or severity of a disease or ailment can often be observed by a sudden drop in production, and remedies can be given before severe damage is done.

It is more necessary for breeders of purebred dairy cattle to keep production records because the sale price of their bull calves and surplus females is largely dependent upon the production record of their dams. Purebred breeders must maintain the

superiority of their purebred animals over grade stock by careful selection and the keeping of production records if fair prices are to be secured for their purebred sale stock.

The Canada Department of Agriculture through their Record of Performance service supervises the testing of all purebred cows. To obtain this service the breeder must place all registered cows on test as long as the herd is on test. Inspectors visit each farm at intervals of from 4 to 6 weeks to weigh and test the milk from each cow. At the end of lactation certificates of production for each cow are issued, based upon the daily weights of milk taken by the breeder or computed from the weights taken by the inspectors. The certificates issued under this system are recognized as the official records of production for all purposes. There is an annual fee of one dollar for each cow tested.

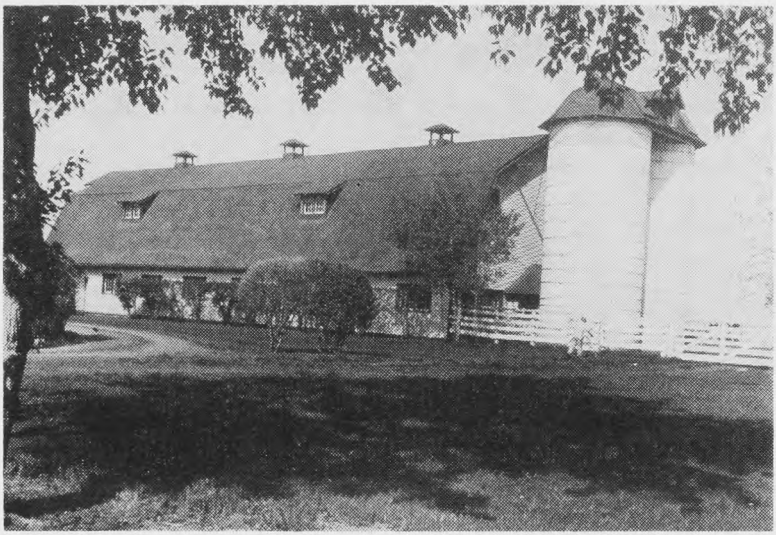

Fig. 13—Dairy barn, University of Alberta, Edmonton, Alta.

The Alberta Department of Agriculture supervises the testing of both purebred and grade herds for the individual breeders of the province. There are two plans offered. Under Plan I the dairyman agrees to weigh the milk of each cow every day and make monthly production reports. Under Plan II the dairyman weighs the milk produced by each cow during a 24-hour period once a month for a computed record. Milk testing is done at testing centers located throughout the province and at the Dairy Branch Laboratory in Edmonton. Under both plans a sample of milk of each cow is taken once a month by the dairyman and forwarded to a testing centre where it is tested by an official of the Dairy

Branch. The cost of the above testing service is $1.00 yearly for every ten cows in the herd.

In addition an "Owner-Sampler Route Plan" service is offered to dairymen in the Edmonton area for both Plan I and Plan II. Under this program a fieldman delivers and picks up the sample boxes monthly from each farm. At the time of his visit he ear-tags all female calves, instructs on sampling and assists the herd owner in analyzing the records. The cost of the "Owner-Sampler Route Plan" is a minimum fee of $10.00 per year for herds up to 10 cows; $15.00 for a herd of 10 to 20 cows; and $20.00 for herds over 20 cows.

Certificates (Blue, Red and Gold seal) are issued for cows meeting certain production requirements under Plan I, and Green seal certificates for cows under Plan II.

Cow testing puts dairying on a business basis and demonstrates to the dairyman how the dairying enterprise can be made more profitable.

Dairy Barn Requirements

Success in dairying cannot be attained without the use of suitable buildings. It is essential that cows be given comfortable and healthy shelter during the winter time, and that facilities be such that milk fit for human consumption can be produced. This does not mean that expensive buildings must be constructed since the essential features can be provided at reasonable cost.

Undue exposure of the cattle to inclement weather during both summer and winter has resulted in heavy losses to dairymen mainly through the lowering of milk production. Dairy cows which receive suitable shelter, feed and care will remain in better health and produce more milk at less cost than cows kept under poor conditions.

There are certain features that are essential in the construction of a suitable dairy barn. It should: (1) be well lighted, (2) be well ventilated, (3) have facilities for maintaining sanitation, (4) have ample space for storing feed, (5) be arranged so that work can be efficiently done, (6) be reasonably warm and free of drafts in a stanchion barn, (7) have permanence, (8) not be too expensive, and (9) be attractive in appearance.

Sunlight is very important.

Good lighting is important for sanitation and health and provides more pleasant conditions for both man and beast. Sunlight kills germs, promotes warmth and ventilation and aids in keeping the barn dry and sanitary. A barn that is dark and damp cannot be kept sanitary. It is not a healthy place for cows to live or man

to work. The production of clean milk in such barns is an impossibility. In constructing a barn, most of the windows should be on the sides getting the most sunshine and so placed that all parts are well lighted. At least five square feet of glass area should be provided for every one hundred square feet of floor space.

Fresh air is as necessary as feed.

Lack of fresh air can seriously affect the health and production of dairy cows. Cows exhale air that contains three times the moisture, one hundred times the carbon dioxide and only three quarters of the oxygen of fresh air. The air cows inhale can also be contaminated with barn odors. Unless good ventilation is provided, barn air soon becomes polluted and unfit for cows to breathe. A suitable ventilating system keeps the air in circulation and fresh.

Several methods of ventilation are being used. Natural ventilation involves the use of inlet and outlet flues so arranged and of the proper size to induce sufficient ventilation. Because natural ventilation has failed to provide sufficient ventilation during certain kinds of weather some dairymen have installed an electric fan or fans to secure the required ventilation.

Sanitation aided by proper barn construction.

Sanitation is obtained not only by providing light and fresh air, but by keeping the barn and cows clean. The barn should be arranged to facilitate easy removal of manure. Cement floors and walls without ledges, sharp corners or crevices, help to promote sanitation because there is less chance for filth to collect and disease bacteria to grow. Sloping floors and gutters with a drainage system to carry away all liquids help greatly to keep the barn dry and sanitary.

Feed storage should be ample.

Dairy cows in milk consume more feed than any other class of farm animals. Barn lofts in which large quantities of hay can be stored save considerable labor. When the herd is large there is an advantage in having the loft equipped with grain bins, storage space for commercial supplements and with facilities for the preparing of concentrate mixtures. Hay and grain chutes should be arranged so as to make roughage and grain feeding easy.

A well arranged barn reduces labor.

The arrangement of the barn should be planned to enable labor to be used most efficiently. Any convenience which simplifies feeding and cleaning reduces labor requirements. In barns with two lines of stanchions, cows can face outward or face the center.

When facing outward the removal of the manure and milking procedure is made easier, while on the other hand when facing the center, feeding can be done more quickly.

Warmth in a barn desirable, but not essential.

Cows do best in a cool barn, temperatures of forty to fifty degrees Fahrenheit being more desirable than higher temperatures. Barns kept at below freezing temperatures have not proven detrimental to cows if provision is made for ample bedding and freedom from cold drafts. The discovery of this fact has led to an increase in the popularity of a new type of barn in which the cows are kept loose in a pen and taken out only at milking time to a milking room of three to five stalls.

Excessive heat in the summer is detrimental to cows, and suitable shelters should be provided in the fields or barn.

Permanent, well-built barns recommended.

If dairying is to be a permanent farm enterprise, it is desirable to construct a barn with essential features for light, ventilation and sanitation. Makeshift, temporary barns usually do not have these features. The use of concrete, stone, or brick for the floors and walls together with steel fittings lengthens the life of the building and provides a more suitable place for cows to live and for clean milk to be produced.

High cost barns not necessary.

Barns that are well constructed, and having all of the essential and desirable features need not be expensive. Such barns may cost more to build, but they usually will last long enough to make the annual cost reasonable. Carefully selected material and equipment made by reputable manufacturers should be purchased.

Build a good-looking barn.

An attractive dairy barn and yards add to the value of a farmstead and to the reputation of the farm and herd. A well proportioned barn of good appearance which is painted to harmonize with the other buildings need not cost any more than a poorly planned, ugly building.

Loose housing dairy barn and milking parlor.

During recent years there has been an increase of interest in loose housing or pen-type barns with milking parlors. New barns of this type have been built and some conventional stanchion barns have been converted to this newer type of barn.

Under this system cows are kept loose in the pen barn at all times where they have free access to hay and water. Ample space is

provided for the cows to lounge when not eating. The manure is not removed during the winter but the surface is kept clean by the addition of fresh bedding. The accumulation of manure and straw provides a warm and comfortable bed on which the cows can lounge when not eating. The barn is kept cold and ventilation provided by keeping windows and doors open.

The cows are milked and fed their grain allowance in the milking room. This milking room contains three, four or more raised stalls and equipment for the milking and milk handling operations, together with facilities for storing and feeding the concentrate mixture. Entrance and exit doors are so arranged to allow a succession of cows to enter the room from the holding pen and to return to the lounging area after being milked.

Advocates of the loose housing system claim the following advantages:

1. Less labor required.
2. Lower barn cost.
3. Fewer injuries to cows.
4. Cleaner milk produced.

From 60% to 80% more bedding has to be provided to keep the cows clean in a loose housing barn as compared to the conventional stanchion barn. Special quarters may have to be provided for cows at calving time and for calves after they are born.

Loose housing barns and milking parlors are more suitable for commercial dairymen than for purebred dairy breeders who wish to give their cows more individual attention in order to show and sell purebred animals.

To obtain more detailed information concerning dairy barns and their construction dairymen should secure Joint Publication No. 7, "Dairy Barns for Alberta," by writing to the Department of Extension, University of Alberta or the Extension Service, Alberta Department of Agriculture, Edmonton.

A "Catalogue of Plans for Dairy Cattle Housing and Equipment" can also be secured from the District Agriculturist or the Extension Service, Alberta Department of Agriculture, Edmonton.

Diseases of Dairy Cattle

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The dairy cow is probably the most highly specialized animal of all our domestic stock. Through generations of selective breeding there has been developed an efficient milk-producing machine.

The development of peak efficiency for milk production has also served to render the animal more susceptible to disease. We cannot expect to find the same rugged disease resistance in a dairy cow that we would expect from a range beef cow.

There is the large, pendulous udder, an organ of wondrous efficiency, but easily bruised or injured and highly susceptible to the disease germs that cause mastitis. Heavy feeding is practiced in most herds in order to maintain high milk production. Such practices place additional strain on the animal and while not in themselves harmful, lack of care on the part of the herdsman in supplying complete rations, or in following accepted feeding practices, can have disastrous results. Calves must be raised the year round and in the case of winter calves, a good standard of sanitation must be constantly maintained.

The failure to observe the principles of good dairy herd management, and recognized ration schedules is an open invitation to disease problems. In the prevention of disease, herd owners can do more than they realize by merely keeping a healthy, well-nourished herd, properly housed, in clean sanitary surroundings.

Unfortunately, disease will occur in the best of dairy herds. When it does, it is strongly advisable to have the services of a qualified veterinarian if one is available. Good nursing of sick animals is essential. The animal should be made as comfortable as possible and supplied with a light, laxative, nourishing diet. Particularly in the colder seasons of the year, keep the animal warm, blanket it and protect it from draughts.

The aim of all dairy herds is maximum efficiency, and efficiency depends upon a healthy, disease-free herd, which itself rests upon proper housing and adequate balanced rations.

BRUCELLOSIS, Bang's Disease.

Brucellosis, often referred to as Bang's Disease or contagious abortion, is one of our most serious diseases of cattle. Not only

is it the most common cause of abortion in our herds, but is also responsible for retained afterbirth, sterility troubles and decreased milk production. And most important too is the fact that the germs which cause Brucellosis in cattle are responsible for undulant fever in man. It is possible for humans to contract undulant fever from a Brucellosis infected cow, either by drinking the raw milk or at times, by merely being in contact with the infected animals.

Cause.

Brucellosis is caused by a bacterium named Brucella abortus. These germs normally live in the genital tract of infected cattle. During pregnancy, the irritation and inflammation they cause in the womb or uterus interfere with the nourishment of the unborn calf, resulting in abortion and retained afterbirth. At calving, the fetal membrane and genital discharges from an infected cow are heavily contaminated with Brucellosis bacteria. If good sanitary practices are not followed these discharges and membranes will serve to spread the infection to clean animals in the herd.

Symptoms.

To best understand the symptoms and course of Brucellosis consider a herd that has been free of infection and has had the disease introduced usually by a purchased cow. The first sign of the disease will be that one cow will abort at any time between the second and seventh month of pregnancy. For a period of two years or more there follows what is commonly called an "Abortion storm". The infection is spreading to the other animals in the herd and 50% or more of the cows will abort. The abortion rate gradually decreases and usually it is only first and second calf heifers that will lose their calves, or Brucellosis free animals that are brought into the herd.

The explanation of this course of the disease is quite simple. Animals that become infected with Brucellosis will usually abort only once; in rare instances we find cows that abort the second time.

It becomes evident, that because a herd is not troubled with abortions, it is not safe to assume that it is free of Brucellosis. Despite normal pregnancies, there are still the attending evils of sterility problems, retained afterbirths and the danger to humans who are handling the animals or consuming raw milk from them. Bulls may become infected with Brucellosis, but they are not as important a factor in the spread of the disease as was formerly believed.

Diagnosis.

The only accurate means of diagnosis is the blood test. Blood samples are drawn by a veterinarian and these samples are sent to the Veterinary Laboratory. In the laboratory it is possible to determine whether or not the animal is affected with Brucellosis from these blood samples. An owner should always suspect Brucellosis whenever there is a history of abortion in the herd, recurrence of retained afterbirth or breeding difficulties.

Prevention and Control.

An owner can do much to prevent the introduction of Brucellosis into his herd.

1. Be careful in the purchasing of new additions to the herd. Records show that most often the disease has been introduced into clean herds by the addition of an infected cow. Have all new animals blood tested before they are brought into the herd.

2. Practice good sanitation, particularly at calving time. The infected cow is spreading the Brucellosis germs constantly but she represents the greatest threat at calving time. The fetal membranes and genital discharges are heavily contaminated with the bacteria. Isolate cows in a clean parturition stall a few days before calving and keep them there until all genital discharges have ceased after calving. Carefully gather up and burn or safely dispose of the afterbirth and all the contaminated litter and bedding.

3. **Calfhood Vaccination.**—By following a calfhood vaccination program, it is possible to raise Brucellosis-free cows in an infected herd. The protection given to calves by vaccination lasts for 4 to 5 years and if a yearly program of vaccination is faithfully followed, it is possible to economically dispose of the Brucellosis infected animals.

Heifer calves are vaccinated between the ages of 6 and 11 months. This requires a qualified Veterinarian. To encourage vaccination, the Canadian Government supplies the vaccine, and the Government of Alberta has organized vaccination campaigns in the various municipalities. As a result, calves can be vaccinated at nominal cost to the owner.

Brucellosis Restricted Areas.

At the request of livestock owners in a municipality, Brucellosis Restricted Areas may be established requiring the compulsory vaccination of all heifer calves. The eventual aim of such a program is to create Brucellosis-free municipalities. Regulations are enforced requiring vaccination of all heifer calves, branding of infected animals, and control of auction sales. There are a number of such areas in Alberta at the present time.

VIBRIOSIS.

An infectious disease of cattle, characterized by abortion and breeding problems. It is known to be present in Alberta.

Cause.

Vibriosis is caused by the bacterium Vibrio fetus. At present the infected bull is regarded as being the main spreader of the disease, cows being infected at breeding. Some females may pick up the infection by contact alone.

Unlike Brucellosis, females will recover from the disease but infected bulls must be considered as being potential carriers for life.

Vibriosis is probably brought into the herd by the introduction of an infected animal.

Symptoms.

It is apparent as a herd problem. Breeding difficulties with or without abortions are common. The abortions occur mainly in the early months of pregnancy but may be as late as the eighth month. Very early abortions are often not recognized as such but rather cows are serviced and return to heat in three or four months. Some animals will require four or more services before conceiving. In herds that have been infected for several years the breeding problems and abortions are confined to heifers and younger animals.

Diagnosis.

Vibriosis is suspected if there is a history of early abortion, return to heat six weeks or more after breeding, and breeding difficulties, especially in heifers and younger animals. The diagnosis can be further supported by blood tests and examination of secretions from the genital tract of cows.

The laboratory examination of aborted fetuses should be carried out whenever possible.

Prevention and Control.

If the disease is suspected obtain qualified advice.

Control measures are based upon the elimination of infected bulls and on the use of a clean bull on the heifers and those cows known to be disease free. Artificial insemination is to be recommended because the antibiotic used in the semen diluent destroys vibrio organisms, if present, and thus prevents herd exposure. The treatment of non-settling cows with antibiotic uterine infusions will help to correct the breeding problem.

Care should be taken when purchasing new animals.

MASTITIS, Garget.

Mastitis is the greatest problem confronting the milk producer. It is a disease of the udder of cows. The disease attacks the udder destroying the milk secreting tissues, with the resulting decrease in milk production. Eventually, the udder is so badly damaged that the cow is no longer an economical milk producer and must be disposed of long before the end of what would ordinarily be her normal period of usefulness.

Cause.

Mastitis is caused by bacteria or germs which gain entrance to the udder through the teat opening. These germs will spread from one animal to another and any injury to the teats or udder serves to make the entrance of these bacteria easier. Heifer calves may become infected by being suckled by calves fed milk from Mastitis cows. This is the reason why heifers are sometimes found to be infected with Mastitis in their first lactation period.

Symptoms.

There are two types of Mastitis, acute and chronic. The acute type is the least common and is usually the result of injury to the udder. It follows a rapid course, with severe swelling and inflammation of the udder and sometimes results in the death of the cow.

The chronic type, though not so rapid in its course, is the greater problem to the dairy herd. The germs of chronic Mastitis will live and develop in an udder for months and years, gradually destroying the milk secreting glands which are replaced by hard, fibrous or scar tissues. This reduces milk production and the quality of the milk as well as the value of the cow.

Throughout this period the milk may be normal in appearance but on occasion, particularly at freshening or during the drying off period the milk will be abnormal, containing flakes, clots and even blood. It must be remembered that in such an animal, despite the normal appearance of the milk, Mastitis germs are damaging the udder and probably spreading to other animals in the herd.

Diagnosis.

Acute Mastitis is quite evident. There is usually a history of injury, and gross swelling and inflammation of the udder. The chronic type is usually recognized by the appearance of flakes, clots and blood in the milk. Accurate diagnosis of Mastitis in a herd may be made where it is possible to have milk samples taken and submitted to the laboratory. Mastitis germs if present, can be found in the milk samples.

The best aid a farmer has is the strip cup. This is a small cup with a fine wire screen over the top of it. The first few streams of milk are directed through the screen and small clots and flakes, if present, will collect on the screen and are readily noticed. Commercial indicator cards which show a color change when moistened with Mastitis milk are of some use, but not as reliable as the regular use of the strip cup.

Prevention and Control.

Good sanitation and proper milking procedures are of prime importance in the prevention and control of Mastitis. The sulfa drugs and penicillin are drugs which are effective in curing some types of the disease, but they should be considered as aids in controlling the disease rather than an absolute cure.

1. Prevent udder injuries by having clean, well drained barn yards. Clean the yard of old machinery, barb wire or objects which might cause injury to teats and udders. Provide ample bedding and stalls of proper length in order that udders will not be hanging in the gutter when the animals are lying down.

2. Have milking machines properly regulated and be scrupulously clean in your milking procedure. Remember that Mastitis germs can be carried from an infected cow to a disease-free one by dirty teat cups of milking machines or the hands of a milker. Wipe udders with a cloth rinsed in warm disinfectant before milking. Dip the teat cups in disinfectant solution between cows. Do not milk onto the floor.

3. Use a strip cup regularly. It is the means of early diagnosis, and early recognition is imperative if treatment is to be successful.

4. Place known infected cows at the end of the milking line and milk them last. Don't carry the germs from an infected cow to a non-infected one.

5. If possible have milk samples taken and sent to the Provincial Veterinary Laboratory, Alberta Department of Agriculture, Edmonton. This will give a complete herd picture and make control easier and more logical.

If a veterinarian is available he should be called for the treatment of Mastitis. Some animals are hopeless cases to treat and should be eliminated from the herd. The farmer can do most in following the simple procedures of good sanitation and proper milking. The sulfa drugs are very effective in certain cases by preventing general blood poisoning. Penicillin is used in the form of penicillin bougies or ointments. These are merely inserted into the teat canal after milking and are quite effective in curing early cases of the disease. Aureomycin, streptomycin and other

newer drugs are available and are used in the same manner as penicillin.

TEAT INJURIES.

These require special attention. If the damage is severe, or if milk is escaping from the wound, it may be necessary to insert sutures and a veterinarian should be consulted.

Cleanliness is important. The area is bathed with warm water. The use of harsh antiseptics is avoided. Antibiotic or sulfathiazole ointments can be used with success. Every effort should be made to keep the area clean until a firm scab has formed. Teat dilators should be used and the quarters milked or drained regularly. The injection of mastitis ointment into the quarter may help to prevent the development of mastitis.

MILK FEVER.

Milk fever is a disease of high producing dairy cows, usually between the ages of 4 and 9 years, and occurs between 12 and 72 hours after calving.

Cause.

Milk fever is believed to be the result of a lack of calcium in the blood. During pregnancy there is a heavy demand for calcium for the bones and tissues of the developing unborn calf, and with the sudden commencement of milk production further calcium is lost and Milk Fever results.

Symptoms.

The disease occurs shortly after calving and the first symptoms of nervousness and excitability are not usually noticed. The animal soon shows difficulty in standing and finally goes down. When down they appear unconscious and the head is often twisted to one side.

Prevention and Treatment.

A veterinarian should be called immediately in cases of Milk Fever. If the blood calcium can be restored by the injection of a calcium solution the animal is up and quite normal in a few hours.

If a veterinarian is not available the inflation of the udder with air may save the animal. Udder inflation outfits may be purchased but in using them care must be taken to see to it that all equipment is scrupulously clean. This method is not without danger but in some instances may be the only means available.

Proper care and feeding of the pregnant animal help in the prevention of the disease.

It is claimed that if an animal is not milked out for a day following calving Milk Fever is often prevented. This is not to be recommended as a regular procedure, but in an animal which seems to suffer from Milk Fever at each calving it may help to prevent its occurrence.

ACETONEMIA.

This is a disease of high producing cows that may or may not be associated with calving. It is sometimes confused with Milk Fever.

Cause.

The exact cause is unknown. It is associated with impaired carbohydrate metabolism, resulting in a lowered blood sugar level and the presence of ketones in the urine.

Symptoms.

Acetonemia occurring shortly after calving is very similar to Milk Fever. It is sometimes a complication of Milk Fever. Acetonemia cows, however, usually show nervousness or increased excitability to some degree. The so-called digestive form, not associated with calving, is characterized by loss of appetite, weight, and marked reduction in milk production.

The diagnosis is based on the presence of ketone bodies in the urine. There is a simple test for this purpose.

Treatment.

Glucose solutions are given intravenously to raise the blood sugar level and carbohydrates are given by mouth. Molasses, corn syrup, glycerine and other preparations as well, given by mouth, have proven to be of value.

As with Milk Fever, a veterinarian should be consulted since intravenous injections cannot be recommended for routine application.

INDIGESTION.

Cattle frequently suffer from indigestion. The large rumen ceases to function properly, loses its muscular movement and the animal is no longer able to eat and digest its food.

Cause.

There are many contributing causes to indigestion in cattle. Often it is the result of nails or other small foreign objects which the animal has swallowed and which cause irritation and inflammation in the rumen or paunch. Overeating of grains, sudden changes of feed, overfeeding of a dry, heavy roughage diet, or the feeding of spoiled or damaged hay, all will cause indigestion.

Symptoms.

In mild cases there is loss of appetite and scanty bowel passages. The animal is dull, stops chewing its cud and milk production is greatly reduced. In some severe cases poisons are absorbed from the intestines, the animal is greatly depressed, unable to stand, the extremities are cold and death soon follows.

Treatment.

Simple indigestion usually responds to a laxative of 1 to 2 pints of raw linseed oil. Tartar emetic, given at the rate of a teaspoonful in 2 quarts of warm water every few hours for 16 hours is helpful in more obstinate cases. If the animal is bloating give an ounce of creolin or turpentine.

Indigestion in cattle is a very serious condition and it is strongly advised that a veterinarian be called if one is available.

BLOAT.

Bloat is a common digestive disturbance in cattle but its cause is not fully understood. It is an excessive production and/or accumulation of gas in the rumen. In acute cases animals will die in a very short time if not treated promptly.

Cause.

It occurs most frequently when cattle are turned on to legume pastures. Alfalfa and clovers will cause bloat, particularly when the pasture is wet. Thick immature stands of alfalfa are considered dangerous. Alfalfa pastures, wilted by a dry spell in the summer, have been known to cause bloat.

Unfortunately the actual reason why legume pastures will cause bloat is not known; although most authorities believe it to be associated with the lack of fiber or roughage quality that stimulates belching under normal conditions.

Symptoms.

In acute cases the symptoms are well marked. It appears suddenly and the left flank is greatly distended with gas. Breathing becomes difficult, the nostrils are dilated, mouth open and the tongue protruded. Moaning or grunting occurs often. The pressure of the gas interferes with the function of the lungs and heart. The gases themselves may exert a toxic effect.

Prevention and Treatment.

Many farmers have used alfalfa pastures without having losses from bloat. One thing to remember is that animals should not be turned into lush legume pastures if they are not accustomed to them.

Certainly they should not have access to them in a hungry state when there is danger of consuming large quantities rapidly. (See page 45 for further recommendations.)

Medicinal treatment consists of the administration of a half pint of kerosene or coal-oil. Two ounces of turpentine or creolin are sometimes effective. These medicines should be given in one quart of milk. A gag of a piece of rope or wood placed in the animal's mouth helps in allowing the gas to escape through the mouth. When emergency treatment is required a trochar and canula should be used. The point of insertion is situated equal distances from the point of the hip, the last rib and the vertebrae or backbone on the left flank. A small incision is made in the skin, the trochar and canula forced through the skin and muscle and into the rumen. The trochar is now removed leaving the sheath or canula in place, allowing the gas to escape. Reinsert the trochar before removing the canula.

The animal should have a light laxative diet for several days after it has suffered from bloat.

WINTER DYSENTERY.

This is a disease of adult stabled cattle that occurs during the winter months and is characterized by severe scouring. It usually follows a mild course but fatalities will occur. It is of common occurrence in dairy herds in Alberta.

Symptoms.

The disease appears suddenly. One or two animals begin to scour and within a few days the greater part of the herd is affected. The scouring is the most marked feature. It is profuse, thin and watery and in some cases even bloodstained. Affected animals lose flesh, and become thin and gaunt in a very short time. Milk production is sharply reduced. The disease runs its course in an animal in from ten days to two weeks, at the end of which time the animal will have recovered.

Treatment.

The animals should be encouraged to drink and fed only a light diet. A tablespoonful of creolin in water, given daily, is often effective. Some recommend a pint of raw linseed oil and two ounces of turpentine. Sulfa drugs may be used in severe cases.

FOOT ROT.

Foot rot is fairly common in some districts of Alberta. It is caused by germs which attack the tissues of the foot. These germs

are found in muddy sloughs, mud holes, and in muddy, poorly drained yards and pens.

Symptoms.

It is first noticed as a lameness. The foot is tender and the animal shows a decided limp. Upon examination swelling is found around the coronet or above the hoof. In time the swelling abscesses and pus exudes. If left unchecked, the foot and leg become greatly enlarged and the bones and hoofs are permanently damaged.

Treatment.

Foot rot can be treated successfully. Injections of drugs directly into the vein, should only be carried out by a qualified veterinarian.

Sulfapyridine, sulfamethazine, or a combination of sulfonamides can be given by mouth at the rate of one grain per pound of body weight. It may be necessary to repeat this treatment in some cases. Penicillin is highly effective, particularly if administered before the foot has broken open and is discharging pus.

The foot itself may be bathed in a warm creolin or copper sulfate solution.

If foot rot is a herd problem fence off mud holes and drain muddy yards. Provide a foot bath of copper sulfate solution or disinfectant and place it at the barn door or by the water trough; any place where the cattle must walk through it daily. Some people report successful control by feeding organic iodine preparations which can be mixed with salt and fed free choice.

STERILITY.

Breeding troubles are all too common in our dairy herds. Often they are the result of disease but quite often, too, the cause is found to be nutritional in origin. Make certain that good balanced rations are fed. See page 18.

The following points may be of some help in the prevention of breeding difficulties:

1. Eliminate or control specific diseases which can be the cause of impaired breeding efficiency.

(a) Brucellosis—see page 69.

(b) Vibriosis—see page 72.

(c) Vaginitis—a disease characterized by redness and inflammation of the vaginal opening. It is believed to interfere with breeding particularly in the early stages of infection. Best results seems to be achieved by withholding breeding

for three heats and the application of a mild disinfectant to the inflamed area of the vagina.

2. Isolate cows at calving time. Provide clean maternity stalls. If assistance is required in calving be sure that the hands and arms are washed thoroughly in warm soapy water. Wash the external genital organs of the cow. Do not use strong, caustic disinfectants. Keep the cow isolated until all genital discharges have ceased.

3. Retained afterbirth is an indication of disease or inflammation of the uterus or womb. Most often it is the result of Brucellosis. If a veterinarian is not available be careful in its removal manually. Never use force; don't be in too much of a hurry, and loosen only those parts which come away easily. Capsules composed of boracic acid or sulfa drugs inserted into the uterus will sometimes prove beneficial. The uterus is very sensitive and is easily permanently damaged by rough treatment or unclean hands and equipment.

4. Never breed a cow when there are still discharges from the genital tract. It might be the indication of contagious disease and the disease may be spread to other cows by the bull.

5. Allow a cow at least one heat period following calving before breeding her. In normal cows, highest conception rate is usually obtained from services 75 to 100 days after calving.

6. Some breeding difficulties are inherited. Try to select cows from good breeding families.

7. Prompt treatment of sterility is often effective where delayed treatment is disappointing. Call your veterinarian early.

CALF SCOURS—WHITE SCOURS.

This is an acute infectious disease of newborn calves occurring during the first few days of life. It is more prevalent during the fall and winter months in stabled calves. The predominant symptom is a white diarrhea but affected animals are soon prostrate and once established the infection will spread to older calves.

Cause.

Scours are caused by germs which are commonly present in stable manure and litter. These germs gain entrance, either orally or through the open navel of the calf. There is no doubt now but that a deficiency of vitamin A is one of the important contributing factors to the disease. Improper feeding, failure to supply the calf with colostrum, and unsanitary feeding practices are all contributing factors.

Symptoms.

The calf is normal at birth but within a few days develops a thin, watery, white-tinged diarrhea. The disease is severe and the animal becomes weak and depressed. Death soon follows. Once established the infection will spread to older calves.

Prevention and Treatment.

Prevention is the most important factor in the control of calf scours.

1. Provide the pregnant animal with a proper diet. The calf receives from the colostrum great quantities of vitamin A. The condition of a newborn animal rests entirely upon the condition of the mother.

2. Provide a clean maternity stall. It should be warm, dry and free of draughts and should be thoroughly cleansed and disinfected before the cow is put into it.

3. At birth disinfect the navel of the calf with tincture of iodine or some other suitable disinfectant.

4. The calf must receive the colostrum milk. This is most important. It supplies the necessary amount of vitamin A as well as antibodies or disease-preventing factors. Then follow a recognized feeding schedule for the raising of young calves.

5. Be scrupulously clean with all feeding utensils used in feeding the calf. If the animal shows an inclination to eat straw or litter it is best to muzzle it. Some recommend the use of a muzzle as a routine procedure to prevent the ingestion of foreign material.

Treatment is not always satisfactory. Once the disease has occurred great care must be taken to prevent its spread to other calves in the barn.

Vitamin A should be provided as feeding oil capsules or commercially prepared tablets. The infection in the intestinal tract is best controlled by the use of commercial calf scours tablets comprised of sulfonamides and antibiotics. These products are readily available.

On premises where the disease recurs a mixed anti-calf scours bacterin may be of some value.

CALF PNEUMONIA.

Pneumonia is a serious disease of dairy calves, most often affecting animals under six months of age. It is most prevalent during the winter months in improperly ventilated barns.

Cause.

Calf pneumonia is the result of infection and once established can spread to all the calves in a herd. As with all respiratory diseases, one finds it occurring most frequently in animals kept in damp, draughty, poorly ventilated stables and barns.

Symptoms.

The first symptoms are dullness, loss of appetite and fever. The breathing soon becomes labored and rapid and coughing is marked. In most cases there is a thick discharge from the nostrils. The disease runs a protracted course with animals dying after several days of severe illness. Abscess formation in the lungs is a common sequel and animals are sometimes permanently affected.

Prevention and Treatment.

Hygiene is most important. Segregate the sick animals to prevent the spread of the disease and provide quarters that are warm, dry and free of draughts.

If possible obtain the services of a veterinarian. Sulfanilimide or sulfamethazine are the best drugs to use in treatment.

A mixed calf pneumonia bacterin may be used as a preventative measure on premises where the disease recurs.

ACTINOMYCOSIS, Lump Jaw.

Cause.

The causative organism gains entrance to the tissues through cuts or abrasions in the lining of the mouth. For this reason it is most often associated with the presence of awns or fox tails in the hay but infection will also occur at the time of the eruption of teeth.

Symptoms.

The soft tissues, tongue or bone may be affected. It first appears as a small hard swelling located on or underneath the jaw. It will gradually increase in size and eventually will interfere with the ability of the animal to eat and drink. Some types will break open and discharge pus. Where the tongue is involved the only noticeable feature is that the tongue becomes quite hard and firm to the touch.

Treatment.

If treated soon enough the disease can be cured or permanently checked. Iodine is a specific remedy. It can be given as potassium iodide at the rate of one tablespoonful dissolved in a pint of water daily as a drench. This is continued until symptoms of iodine

poisoning appear as evidenced by watery eyes and dry, scaly skin. Treatment is stopped at this point but can be repeated in ten days. Several courses of treatment may be necessary. Cows in the late stages of pregnancy should not be treated. In valuable animals surgery may be worthwhile.

Small hard lumps that are commonly observed on the jaw of young calves are not lump jaw but should be opened and drained.

WOUNDS.

The principles involved in the treatment of any wound are:

1. Control bleeding.
2. Cleanse the area.
3. Apply an antiseptic.

Most injuries heal more quickly as open wounds and attempting to suture them will only result in delayed healing.

Bleeding is controlled by pressure pads or bandage. The wound is gently bathed with warm water until as much as possible of any foreign material is removed. Tincture of iodine is then applied.

For large raw areas a sulfathiazole urea dusting powder is highly effective.

Commercial wound dressings are available.

RINGWORM.

This is a skin disease which affects the calves and younger animals. It is caused by a fungus which burrows into the skin, destroying the hair roots, with the resulting loss of hair on the lesion. It will spread from animal to animal and to humans.

Symptoms.

As the fungus grows in the skin it causes the loss of hair in characteristic round circular lesions, forms a thick black crusty scab. These lesions are found chiefly in the region of the head and neck, although they are sometimes present in other areas. Calves and younger animals are most frequently attacked but adult cattle are also susceptible.

Treatment.

Remove the scabs by scrubbing with a stiff brush and warm soapy water. The application of iodine in any form is effective treatment. Tincture of iodine may be applied with a small brush or iodine ointment used.

Segregate affected animals to prevent the spread to other animals and exercise care in handling as the disease can be spread to humans.

TUBERCULOSIS.

Fortunately the percentage of Alberta cattle infected with tuberculosis is quite small. Tuberculosis is caused by a germ called the tubercle bacillus. An animal may be suffering from tuberculosis and yet show no visible symptoms of the disease. Such an animal can readily spread the disease to non-infected animals and represents a threat to humans consuming milk from it or eating the meat from it after it has been slaughtered. Tuberculosis cannot be tolerated in any of the domestic livestock.

The tuberculin test is used to diagnose tuberculosis in cattle. The test requires a veterinarian and there are several methods by which it may be applied. The one most commonly used is the intradermal test. A few drops of tuberculin are injected into the fold of skin at the base of the tail and if the animal is affected with tuberculosis a reaction or swelling can be observed in from 72 to 96 hours after the injection.

Tuberculosis control is under the supervision of the Canadian Government. There are several plans or policies for tuberculosis eradication.

Accredited Herd Plan.

The object of this plan is the eradication of tuberculosis in purebred herds. These herds are tuberculin tested free of charge by Dominion Veterinarian Inspectors. All animals which react to the tuberculin test are branded on the cheek with a large "T" and must be sold for slaughter under federal supervision.

To be eligible for acceptance under this plan a herd must contain at least ten purebred cattle of one breed registered in the applicant's name. The number of purebreds must, however, comprise at least one-third of the total number of cattle in the herd.

As soon as the herd has passed two annual or three semi-annual tests, without a reactor, and contains at least ten registered purebreds, it is designated as a "Tuberculosis-free Accredited Herd."

Compensation paid for reactors is based on two-thirds of the valuation placed upon the animals by Veterinary Inspectors of the Health of Animals Division. The maximum compensation paid under the Act is $60.00 for purebreds and $40.00 for grades. Should the meat of the animal be unfit for human consumption, the Canadian Government will also pay, in addition, compensation equal to the market value of the carcass. Compensation on a pure-

bred basis is not paid for reacting animals over six months of age, not registered at the commencement of the tuberculin test. Animals affected with lump jaw and grade bulls are not eligible for compensation.

Restricted Area Plan.

The object of this plan is the eradication of tuberculosis in definite areas. At least two-thirds of the cattle owners in any definite area must sign a petition for the establishment of such an area under this plan. The petition must be forwarded by the Provincial Minister of Agriculture to the Minister of the Canada Department of Agriculture requesting that the necessary action be taken. The payment of compensation is based on the same limitations and maximum valuations provided under the Accredited Herd Plan.

The entire province is now officially recognized as a Restricted Area although the actual testing will not be completed for several years.

Gestation Table for Cows

Month

Breeding Dates	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Day	Calving Dates											
1	Oct. 10	Nov. 10	Dec. 8	Jan. 8	Feb. 7	Mar. 10	Apr. 9	May 10	June 10	July 10	Aug. 10	Sept. 9
2	11	11	9	9	8	11	10	11	11	11	11	10
3	12	12	10	10	9	12	11	12	12	12	12	11
4	13	13	11	11	10	13	12	13	13	13	13	12
5	14	14	12	12	11	14	13	14	14	14	14	13
6	15	15	13	13	12	15	14	15	15	15	15	14
7	16	16	14	14	13	16	15	16	16	16	16	15
8	17	17	15	15	14	17	16	17	17	17	17	16
9	18	18	16	16	15	18	17	18	18	18	18	17
10	19	19	17	17	16	19	18	19	19	19	19	18
11	20	20	18	18	17	20	19	20	20	20	20	19
12	21	21	19	19	18	21	20	21	21	21	21	20
13	22	22	20	20	19	22	21	22	22	22	22	21
14	23	23	21	21	20	23	22	23	23	23	23	22
15	24	24	22	22	21	24	23	24	24	24	24	23
16	25	25	23	23	22	25	24	25	25	25	25	24
17	26	26	24	24	23	26	25	26	26	26	26	25
18	27	27	25	25	24	27	26	27	27	27	27	26
19	28	28	26	26	25	28	27	28	28	28	28	27
20	29	29	27	27	26	29	28	29	29	29	29	28
21	30	30	28	28	27	30	29	30	30	30	30	29
22	31	Dec. 1	29	29	28	31	30	31	July 1	31	31	30
23	Nov. 1	2	30	30	Mar. 1	Apr. 1	May 1	June 1	2	Aug. 1	Sept. 1	Oct. 1
24	2	3	31	31	2	2	2	2	3	2	2	2
25	3	4	Jan. 1	Feb. 1	3	3	3	3	4	3	3	3
26	4	5	2	2	4	4	4	4	5	4	4	4
27	5	6	3	3	5	5	5	5	6	5	5	5
28	6	7	4	4	6	6	6	6	7	6	6	6
29	7	....	5	5	7	7	7	7	8	7	7	7
30	8	....	6	6	8	8	8	8	9	8	8	8
31	9	....	7	....	9	....	9	9	....	9	....	9